

Phase II
Remedial Investigation
for
Naval Submarine Base
New London
Groton, Connecticut
Volume I - Text



Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0129

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Brown & Root Environmental

A Division of Halliburton NUS Corporation

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**PHASE II
REMEDIAL INVESTIGATION REPORT
FOR
NAVAL SUBMARINE BASE, NEW LONDON
GROTON, CONNECTICUT**

VOLUME I - TEXT

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
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10 Industrial Highway, Mail Stop #82
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**Submitted by:
Brown & Root Environmental
993 Old Eagle School Road, Suite 415
Wayne, Pennsylvania 19087-1710**

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PREPARED BY:

APPROVED BY:

**MATTHEW G. COCHRAN, P.G.
PROJECT MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA**

**JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
BROWN & ROOT ENVIRONMENTAL
WAYNE, PENNSYLVANIA**

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GLOSSARY

ACGIH - American Conference of Governmental Industrial Hygienists

Acid Volatile Sulfide (AVS) - The most unstable fraction of the three broad classes of sulfides in sediments (i.e., AVS, sulfide mineral phase, and organic sulfide associated with organic matter in sediments). AVS is associated with the more soluble iron and manganese monosulfides, and has an affinity for many metals that are of toxicological concern.

Advection - Movement as a result of the bulk flow of a fluid.

Aliphatics - Straight-chain hydrocarbons and their cyclic counterparts.

Amphipod - A crustacean with a laterally compressed body (e.g., freshwater shrimp).

Anisotropic - The condition under which one or more of the hydraulic properties of an aquifer vary according to the direction of flow.

Aquifer - Rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Aromatics - Chemicals which consist of one or more rings and exhibit properties similar to benzene.

Artesian - A condition where the water level in a well is higher than the elevation of the top of the aquifer. Such a condition can arise as a result of geologic features or topography.

Assessment Endpoint - Formal expressions of the actual environmental values to be protected.

ATSDR - Agency for Toxic Substances and Disease Registry.

AWQC - Ambient Water Quality Criteria.

BCF - Bioconcentration factor.

Benthic - Referring to organisms living on or in the bottom sediments.

Benthos - The bottom sediments and the organisms living there.

Bioaccumulation - The retention and concentration of chemicals in an organism.

Bioassay - A test that determines the effect of a chemical on a living organism.

Bioavailability - The extent and rate at which a substance (e.g., contaminant) is absorbed into a living system or is made available at the site of physiological activity.

Bioconcentration - The accumulation of a chemical in an organism to levels that are greater than the medium in which the organisms resides (e.g., fish in water).

Biomagnification - The tendency of some chemicals to accumulate to higher concentrations as trophic level increases, through dietary uptake.

BOD - Biochemical Oxygen Demand.

Cation - A positively charged atom or group of atoms.

CDDs - Chlorinated dibenzo-p-dioxins.

CDFs - Chlorinated dibenzofurans.

Chronic - Over a long period of time, either continuously or intermittently.

CLP - Contract Laboratory Program.

COC - Chemical of Concern.

Confining Unit - A body of material of low hydraulic conductivity that is stratigraphically adjacent to (above or below) one or more aquifers.

CRDL - Contract Required Detection Limit.

CRQL - Contract Required Quantitation Limit.

CSF - Cancer Slope Factor.

CTE - Central Tendency Exposure.

Dip - The angle that a stratum or any planar feature makes with the horizontal, measured perpendicular to the strike and vertical plane.

Divalent Metal - A charged or uncharged metal that has formed two covalent bonds.

DQOs - Data Quality Objectives.

Drawdown - A lowering of the water table of an unconfined aquifer or the potentiometric surface of a confined aquifer caused by pumping of groundwater from wells.

Epibenthic - Referring to organisms living on, as opposed to within, bottom sediments.

Equilibrium - A condition in which no change occurs in the state of a system as long as its surroundings are unaltered.

Equilibrium Partitioning (EqP) Method - The prescribed methodology used to predict the bioavailability of metals and nonpolar ionic chemicals present in sediments for use by the U.S. Environmental Protection Agency in deriving national sediment criteria. The methodology is based on a chemical's tendency to partition between sediment organic content and water.

Equipotential Line - A line connecting points of equal hydraulic head.

Estuary - Drainage channel adjacent to the sea in which the tide ebbs and flows.

Gneiss - A coarse grained rock with alternating bands of granular minerals and subparallel-oriented micaceous minerals.

HEAST - Health Effects Assessment Tables.

HI - Hazard Index.

HQ - Hazard Quotient.

Hydraulic Conductivity - An intrinsic property of an aquifer that affects the rate at which a fluid flow through the material (a measure of the degree of interconnectedness of the pore spaces and the volume of the pore spaces relative to the total volume of the material). The hydraulic conductivity is also a function of the fluid under consideration.

Hydraulic Gradient - The change in total head with a change in distance in a given direction. The direction is that which yields a maximum rate of decrease in head.

ICP - Inductively Coupled Plasma.

ILCR - Incremental Lifetime Cancer Risk.

Interstitial Water - The water contained in pore spaced between the grains of sediment.

IRIS - Integrated Risk Information System.

Joint - A planar break in rock without relative movement of rocks on either side of the break.

Kd - Distribution Coefficient.

K_{oc} - Organic carbon partition coefficient.

K_{ow} - Octanol/water partition coefficient.

LC₅₀ - The concentration of material in water to which test organisms are exposed that is estimated to be lethal to 50% of the test organisms. The LC₅₀ is usually expressed as a time-dependent value (e.g., 24-h or 96-hr LC₅₀; the concentration estimated to be lethal to 50% of the test organisms after 24 or 96 hr of exposure).

Lithology - The science that deals with the microscopic mineral characteristics of rocks.

Lowest Observed Adverse Effects Level (LOAEL) - The lowest concentration of a material in water used in a toxicity test that has a statistically significant adverse effect on the exposed population of test organisms as compared to the controls.

Measurement Endpoint - Quantitative expressions of an observed or measured effect of a hazard that corresponds to or predicts assessment endpoints.

MCL - Maximum Contaminant Level.

MCLG - Maximum Contaminant Level Goal.

No Observed Adverse Effects Level (NOAEL) - The highest concentration of a material in a toxicity test that has no statistically significant adverse effect on the exposed population of test organisms as compared to the controls.

Nonpolar Chemicals - Chemical molecules which have no separation of positive and negative charge (i.e., there are not positive and negative poles).

NTU - Nephelometric Turbidity Units.

Organic Carbon - The amount of organic material in a given medium, usually sediment.

OSWER - Office of Solid Waste and Emergency Response.

Overburden - The upper part of a sedimentary deposit, compressing and consolidating the material below. In this report, overburden refers to all materials located between ground surface and the bedrock surface.

PAH - Polycyclic aromatic hydrocarbons.

PCB - Polychlorinated biphenyls.

pH - An alternate way of expressing the H^+ ion concentration; $pH = -\log_{10}[H^+]$.

Pharmacokinetics - The dynamic behavior of chemicals inside biological systems including uptake, distribution, metabolism, and excretion.

PM10 - Particulate matter with diameters of 10 microns or less.

Polychaete - An order of primarily marine worms having bristles on the body segments.

Potentiometric Surface - A surface that represents the level to which water will rise in tightly cased wells. If the hydraulic head varies significantly with depth within an aquifer, then there may be more than one potentiometric surface for the aquifer. The water table is a particular potentiometric surface for an unconfined aquifer.

QA - Quality Assurance.

QC - Quality Control.

Reference Area - A relatively unimpacted (unpolluted) site having essentially the same ecological and physical properties used for comparison to the impacted (polluted) site being evaluated.

RfC - Reference Concentration.

RfD - Reference Dose.

RI - Remedial Investigation.

RME - Reasonable Maximum Exposure.

RPD - Relative Percent Difference.

Simultaneously Extracted Metals (SEM) - Metals, commonly cadmium, copper, lead, nickel and zinc, that form less soluble sulfides than do iron and manganese, and which are at least partially soluble. These metals are extracted from a sample simultaneously with the AVS.

Specific Yield - The ratio of the volume of water a rock or soil will yield by gravity drainage to the volume of the rock or soil. Gravity drainage may take many months to occur.

SSL - Soil Screening Level.

STEL - Short-Term Exposure Limit.

Stratified Drift - Sorted or layered material deposited by a melt water stream or settled from suspension in a body of quiet water adjoining a glacier.

Strike - The direction taken by a structural surface, e.g. a bedding or fault plan, as it intersects the horizontal.

Storativity - The volume of water that an aquifer releases per unit surface area per unit decline in the hydraulic head.

Subchronic - Of intermediate duration, usually for periods between 5 and 90 days.

TEFs - Toxicity Equivalent Factors.

TLV - Threshold Limit Value.

TOC - Total Organic Carbon.

Toxicity - Refers to harmful effects resulting from exposure to a toxic substance.

TPH - Total petroleum hydrocarbons.

Transmissivity - The capacity of an aquifer to transmit water. The hydraulic conductivity multiplied by the saturated thickness of the aquifer.

Trophic Level - Any of the feeding levels through which the passage of energy through an ecosystem proceeds. organisms at higher trophic levels feed on organisms at lower trophic levels.

TWA - Time-Weighted Average.

UCL - Upper Confidence Limit.

Vadose Zone - The unsaturated soil zone above the water table. The void spaces in this zone are only partially filled with water (i.e., the moisture content is less than the porosity).

Water Column - A vertical cross-section (i.e., profile) of a body of water or a columnar cross-section of a body of water at a selected location.

EXECUTIVE SUMMARY

This Phase II Remedial Investigation (RI) report has been prepared for the Department of the Navy, Northern Division Naval Facilities Engineering Command by Brown & Root Environmental (BRE) under Contract Number N62472-90-D-1298, Contract Task Order 129. This report summarizes the results of a Phase II Remedial Investigation for 13 distinct sites/areas at the Naval Submarine Base - New London (NSB-NLON), located in Groton, Connecticut. The 13 sites/areas studied during the Phase II RI are as follows:

- Construction Battalion Unit (CBU) Drum Storage Area - Site 1
- Area A Landfill - Site 2
- Area A Wetland - Site 2
- Area A Weapons Center - Site 20
- Area A Downstream Watercourses and Over Bank Disposal Area (OBDA) - Site 3
- Rubble Fill Area at Bunker A-86 - Site 4
- Defense Reutilization and Marketing Office (DRMO) - Site 6
- Torpedo Shops - Site 7
- Former Goss Cove Landfill - Site 8
- Lower Subbase
- Over Bank Disposal Area Northeast (OBDANE) - Site 14
- Spent Acid Storage and Disposal Area (SASDA) - Site 15
- Thames River

The remainder of this executive summary provides a brief summary of the nature and extent of contamination at each of the individual sites/study areas, summarizes the results of the baseline risk assessment, and provides recommendations regarding additional investigatory efforts. Each of the sites/study areas are discussed in Sections E.1 through E.13. An overall summary of recommendations is provided in Section E.14.

E.1 CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA

This section presents a summary of major findings for the CBU Drum Storage Area. A summary of the nature and extent of contamination is provided in Section E.1.1. Sections E.1.2 and E.1.3 summarize the baseline human health risk assessment and the ecological risk assessment for the site, respectively. Section

E.1.4 summarizes the comparison of site data to state standards and Section E.1.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.1.1 Nature and Extent of Contamination

Various organic and inorganic chemicals were detected in soil and groundwater samples collected at the CBU Drum Storage Area site. For the most part, the concentrations encountered were relatively low. For example, although various volatile organics were detected in the soil, the concentrations were all less than 400 $\mu\text{g/kg}$. The concentrations of semivolatile organics were somewhat higher, particularly those of several PAHs, such as fluoranthene with a maximum concentration of 16,000 $\mu\text{g/kg}$. Other chemicals detected in the soil matrix included relatively immobile compounds such as 4,4'-DDT (3,900 $\mu\text{g/kg}$), Aroclor-1248 (420 $\mu\text{g/kg}$), and Aroclor-1254 (360 $\mu\text{g/kg}$). Inorganic chemicals were detected in the soil samples in excess of NSB-NLON background levels.

Two unfiltered groundwater samples collected from one well at the CBU Drum Storage Area contained various organic compounds including chlorobenzene, xylenes, 4-methylphenol, diethylphthalate, various PAHs. Concentrations of these chemicals were all less than 31 $\mu\text{g/L}$. Various inorganics were also detected in the filtered and unfiltered groundwater samples.

Based on the available analytical results, it is concluded that although some contamination exists at the CBU Drum Storage Area, it is essentially negligible. The groundwater sample results indicate that the chemicals in soil at the site (which are primarily immobile compounds such as PAHs, pesticides, and PCBs) have not impacted the groundwater.

E.1.2 Baseline Human Health Risk Assessment

The CBU Drum Storage Area is a relatively isolated site and the baseline human health risk assessment focused on exposure scenarios for an older child trespasser and a construction worker. Given current and anticipated future land and water use, these receptor groups are considered appropriate for the site. All of the noncarcinogenic risks (HIs) for these receptor groups were below unity. Incremental lifetime cancer risks were either less than $1\text{E-}6$ or well within the USEPA's target acceptable risk range. Therefore, it is concluded that the site poses minimal risk to human health.

E.1.3 Baseline Ecological Risk Assessment

The CBU Drum Storage Area is currently characterized by compacted soil that supports limited vegetation and provides no habitat for ecological receptors. Using the conservative assumptions discussed in Section 3.4.4.2, maximum concentrations of contaminants detected in site surface soils (0 to 2 feet) were compared to benchmark values protective of various terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. When the risks associated with the average surface soil concentrations were evaluated, risks to these receptors were reduced but still exceeded 1.0. However, because of the current site conditions, actual risks to ecological receptors are likely to be much less than those calculated for this area. Areas bordering the CBU Drum Storage Area (e.g., the wooded hillside) do represent desirable habitat for wildlife. Organisms inhabiting this area may come in contact with soil contaminants associated with the site while moving through the area to forage in the nearby Area A Wetland or Area A Downstream Watercourses. While potentially exposed to soil contaminants, this exposure is much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby reducing the actual ecological risks associated with this site. The site is relatively small in aerial extent and is characterized by compacted soil which limits the available habitat to ecological receptors. In addition, this site is to be capped as part of the Area A Landfill interim remedial action (see Section 5.6.2); capping the CBU Drum Storage Area will eliminate the possibility that ecological receptors will come in contact with site contaminants. When the current and future site conditions are factored into this evaluation, it is concluded that the CBU Drum Storage Area represents little potential risk to ecological receptors.

E.1.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 5.8. Although not retained as COCs in the baseline human health risk assessment, dieldrin and heptachlor epoxide were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. This indicates that although detected concentrations were less than human health risk-based COC screening levels, these soil compounds may migrate to groundwater and potentially impact water quality.

For groundwater, minimal exceedances of state standards were observed. Sodium and phenanthrene were the only groundwater chemicals which were not selected as COCs in the baseline human health risk assessment. No dose-response parameters are available to quantitatively address exposure to these two chemicals. It should be noted that the applicable state standard for sodium is a Notification Level of a drinking water source.

E.1.5 Recommendations

It is recommended that the CBU Drum Storage Area be considered for no further action based on the following information:

- The potential source of contamination which was discovered during the 1982 IAS (26 55-gallon drums containing waste oil, lube oil, and paint materials) has been removed and no visual evidence of contamination remains at the site.
- Soil and groundwater samples collected in the vicinity of the site yielded, for the most part, relatively low concentrations of chemicals. Volatile organic compounds were detected in soil samples at concentrations less than or equal to 380 $\mu\text{g}/\text{kg}$. Only two volatile organic compounds (chlorobenzene and total xylenes) were detected in groundwater at concentrations of 12 and 24 $\mu\text{g}/\text{L}$, respectively. All semivolatile organics compounds in groundwater were detected at concentrations less than or equal to 31 $\mu\text{g}/\text{L}$.
- The human health risk assessment concluded that carcinogenic risks were all within USEPA acceptable risk range of $1\text{E-}4$ to $1\text{E-}6$ or below $1\text{E-}6$. Noncarcinogenic risks were below the USEPA acceptable level of one for all receptor groups.
- The potential for this site to impact ecological receptors from a realistic perspective, is low. Although the ecological risk assessment concluded that chemicals associated with this site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates; the calculations were performed using highly conservative estimates. Furthermore, the site is relatively small in aerial extent (15 feet wide, 30 feet long) and is characterized by compacted soil that supports limited vegetation and terrestrial species. Therefore, the CBU Drum Storage Area does not provide a significant habitat for ecological receptors.
- The site, which is located within the boundary of the Area A Landfill, will be covered with a low permeability cap as part of the planned interim remedial action for the Area A landfill. This cap, which is currently under construction, will eliminate the possibility of potential human and ecological exposure to soil at the site. Furthermore, the cap will minimize the amount of precipitation that could infiltrate through the soil and potentially transport contamination to the groundwater.

E.2 AREA A LANDFILL

This section presents a summary of major findings of the investigations for the Area A Landfill. A summary of the nature and extent of contamination is provided in Section E.2.1. Sections E.2.2 and E.2.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.2.4 summarizes the comparison of site data to state standards and Section E.2.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.2.1 Nature and Extent of Contamination

Relatively high concentrations of various organic and inorganic chemicals were detected in a few soil samples collected from the Area A Landfill. Examples included such chemicals as ethylbenzene (28,000 $\mu\text{g/kg}$), xylenes (140,000 $\mu\text{g/kg}$), chlorobenzene (4,500 $\mu\text{g/kg}$), Aroclor-1254 (100,000 $\mu\text{g/kg}$), Aroclor-1260 (12,000 $\mu\text{g/kg}$), and several PAHs. Contamination in the landfill materials appears to be relatively sporadic. Many of the soil samples collected exhibited only minimal or no contamination.

Groundwater samples collected at this site also demonstrated the sporadic presence of organic chemicals. Benzene, ethylbenzene, xylenes, dichlorobenzene isomers, naphthalene, 2 methylnaphthalene, 1,1,2,2-tetrachloroethane, and trichloroethene are some of the compounds detected in the groundwater samples. Concentrations of these analytes ranged as high as 1,200 $\mu\text{g/L}$ (chlorobenzene). It should be noted that the majority of contamination is limited to the shallow groundwater. Only one deep monitoring well, 2LMW13D contained organic compounds. Based on the available analytical results, it is concluded that the Area A Landfill contains several potentially mobile chemicals at relatively high concentrations and is acting as a source of groundwater contamination.

E.2.2 Baseline Human Health Risk Assessment

The baseline human health risk assessment for the Area A Landfill site considered the potential exposure of multiple receptor groups (including full-time workers, older child trespassers, and construction workers). The assessment demonstrated that construction workers may incur incremental lifetime cancer risks exceeding the upper bound of the USEPA's target risk range ($1\text{E-}4$). Elevated noncarcinogenic hazards were estimated for all receptor groups. Based on the results of the risk assessment, it is concluded that the Area A Landfill may pose a threat to the public health and to the groundwater at the facility under the defined exposure scenarios. All potential toxic effects for the Area A Landfill are attributed to PCBs.

E.2.3 Ecological Risk Assessment

As described in Section 6.3.6, the Area A Landfill currently represents generally limited wildlife habitat due to its gravel cover, the pavement covering the landfill's concrete pad and proximity to areas of high human activity (e.g., the Area A Weapons Center). The Area A Landfill does border areas that do represent potential wildlife habitat or may provide cover for ecological receptors. Using the conservative assumptions discussed in Section 3.4.4.2, both the maximum and average concentrations of chemicals detected in surface soils (0 to 2 feet) collected from this site exceeded benchmark values protective of various terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. Potential risks to terrestrial vegetation and soil invertebrates were associated with the presence of heavy metals. Potential risks to vertebrate species were almost entirely associated with OCDD, a compound closely related to TCDD. These results indicate that if the Area A Landfill provided habitat and forage for terrestrial receptors, organisms utilizing this area would potentially be at risk. However, because of the current conditions associated with this site, actual risks to ecological receptors are likely to be much less than those calculated for this area. Areas bordering the Area A Landfill (e.g., the wooded hillside) do represent desirable habitat for wildlife. Organisms inhabiting this area may come in contact with soil contaminants associated with the site while moving through the area to forage in the nearby Area A Wetland or Area A Downstream Watercourses. While potentially exposed to soil contaminants, this exposure is much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby reducing the actual ecological risks associated with this site. In addition, this area is to be capped (see Section 6.1); capping the Area A Landfill will eliminate the possibility that ecological receptors will come in contact with these chemicals. When the current and future site conditions are factored into this evaluation, it is concluded that the Area A Landfill represents little potential risk to ecological receptors.

E.2.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 6.8. Although not retained as COCs in the baseline human health risk assessment, ethylbenzene, xylenes, phenanthrene, dieldrin and heptachlor were reported at maxima in excess of Connecticut remediation standards for pollutant mobility.

While these compounds may migrate to groundwater and potentially impact water quality, no dose-response parameters are available to quantitatively evaluate exposure to phenanthrene, and detected maximum concentrations for the remaining chemicals were less than human health risk-based COC screening levels for soil ingestion.

For groundwater, maxima of a few chemicals (xylenes, phenanthrene, copper, sodium, and zinc) exceeded the applicable state standards, but were not identified as COCs in the baseline human health risk assessment. No dose-response parameters are available to quantitatively address exposure to phenanthrene and sodium. It should be noted that the applicable state standard for sodium is a Notification Level for a drinking water source. The remaining chemicals were reported at concentrations less than the risk-based COC screening levels for tap water ingestion.

E.2.5 Recommendations

It is recommended that a "limited action" approach, involving a groundwater monitoring program and access/use restrictions be implemented at the Area A Landfill, in addition to the planned Area A Landfill cap. This recommendation is based on the following information:

- Relatively high concentrations of organic and inorganic chemicals were detected in a few soil samples at the site. The soil contamination appears to be located sporadically throughout the site.
- Groundwater contamination exists at the site and is primarily limited to the shallow groundwater.
- Noncarcinogenic hazards exceed the USEPA acceptable limit of one for all receptor groups with the exception of the CTE older child trespasser and the CTE full-time employee. Lifetime incremental carcinogenic risks exceed the upper bound ($1E-4$) of USEPA's acceptable target risk range for the construction worker under the RME scenario. Therefore, the landfill may pose a threat to human receptors at the facility. This threat is due entirely to the presence of PCBs at the site.
- Chemicals in the soil could adversely impact ecological receptors. It should be noted, however, that the site does not provide a desirable ecological habitat and highly conservative assumptions were used to evaluate ecological risks. Furthermore, the installation of the cap will eliminate risks to ecological receptors.

As required by the September 1995 ROD, the Navy is planning to cap the Area A Landfill and to intercept the upgradient surface runoff and shallow groundwater before entering the site as part of an Interim Remedial Action (IRA). Groundwater at this site will also be monitored as required by the ROD. The planned IRA will eliminate the dermal contact exposure route and reduce infiltration and subsequent contaminant loading to the groundwater. The IRA was originally intended to address minimization of risk

associated with soils at this site pending the outcome of this Phase II RI effort, which would address all remaining media. However, the components of the IRA (cap, upgradient surface runoff and shallow groundwater interception, and long-term post-closure shallow and deep groundwater monitoring) are presently addressing all media of concern identified in this report (soil and groundwater). The need for remedial action for groundwater at this site will be evaluated as the results of the groundwater monitoring program become available.

E.3 AREA A WETLAND

This section presents a summary of major findings of the investigations for the Area A Wetland site. A summary of the nature and extent of contamination is provided in Section E.3.1. Sections E.3.2 and E.3.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.3.4 summarizes the comparison of site data to state standards and Section E.3.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.3.1 Nature and Extent of Contamination

Various media including surface water, groundwater, sediment, and soil were sampled at the Area A Wetland during the Phase II RI. For the most part, very little evidence of groundwater and surface water contamination was evident in the samples collected at this site. For example, carbon disulfide ($2\text{ }\mu\text{g/L}$ in one sample) and xylenes ($1\text{ }\mu\text{g/L}$ in one sample) were the only volatile organics detected in groundwater samples. Low concentrations of various semivolatile organics were detected in the groundwater. Bis(2-ethylhexyl)phthalate was detected at the highest concentration ($30.5\text{ }\mu\text{g/L}$). Only one organic chemical (tetrachloroethene) was detected in surface water at the site. This compound was detected in one of nine samples obtained at the site, and the concentration was $2\text{ }\mu\text{g/L}$.

Several volatile organics were detected in the sediment and soil matrices, although most concentrations are also relatively low. The most concentrated volatile organic detected was 2-butanone ($1,400\text{ }\mu\text{g/kg}$). By contrast, relatively high concentrations of various PAHs were found in the sediment and surface soil samples. Concentrations of these analytes ranged as high as $80,000\text{ }\mu\text{g/kg}$ (fluoranthene). Several pesticides and one PCB (Aroclor-1260 at a maximum concentration of $1,500\text{ }\mu\text{g/kg}$) were also detected in the sediment samples. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected most frequently and at the highest concentrations (up to $4,800\text{ }\mu\text{g/kg}$). Chemicals detected at high concentrations in the solid matrices are all considered to be relatively immobile in the environment, as a result of their relatively low solubilities and/or high absorption tendencies.

E.3.2 Baseline Human Health Risk Assessment

The baseline risk assessment for the Area A Wetland focused on an older child trespasser and a construction worker. Exposure to surface water, soil/sediment, and groundwater were considered.

Noncarcinogenic risks (HIs) for the construction worker and older child trespasser under the RME scenario exceeded unity. However, no toxic effects are anticipated for the older child trespasser since chemicals contributing the most to the cumulative risks for this receptor do not impact similar target organs. For the construction worker, manganese (groundwater) contributes significantly to the elevated noncarcinogenic risks. It should be noted that manganese is relatively abundant in the environment.

Lifetime incremental cancer risks for the CTE scenarios for the trespasser and construction worker were less than $1\text{E-}6$, the lower bound of the USEPA target risk range. Lifetime incremental cancer risks exceeded $1\text{E-}6$ for the RME trespasser ($4.2\text{E-}5$) and the RME construction worker ($1.2\text{E-}5$). Primary contributors to the cancer risk estimates for both receptors include PAHs and arsenic.

E.3.3 Ecological Risk Assessment

The Area A Wetland is dominated by the reed *Phragmites communis*. While providing cover, no wildlife species are known to utilize this emergent as a food source. The dominance of the wetland by *Phragmites* diminishes the habitat quality of this area. However, areas near the wetland do provide good habitat for ecological receptors that may forage in the wetlands and use it as a source of drinking water. Organisms utilizing this area may come in contact with surface water, sediments, and soil contaminants associated with the site while searching for food, ingesting water and prey, or burrowing in the soil (e.g., soil invertebrates). Using the conservative assumptions discussed in Section 3.4.4.2, the maximum chemical concentrations in these three media were compared to benchmark values protective of various aquatic and terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact aquatic biota, terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. When the risks associated with the average concentrations were evaluated, risks to these receptors were somewhat reduced but still exceeded 1.0. These results suggest that chemicals detected in surface water, sediment, and surface soil at the Area A Wetland represent a potential risk to both aquatic and terrestrial receptors.

E.3.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 7.8. Fluoranthene, pyrene, and dieldrin in the soil and sediment samples were not retained as COCs in the baseline human health risk assessment, but were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. Although detected concentrations were less than risk-based COC screening levels, these soil/sediment compounds may migrate to groundwater and potentially impact water quality.

For groundwater, sodium was the only chemical which exceeded a state standard, but was not retained as a COC for the human health risk assessment. It should be noted that the applicable state standard for sodium is a Notification Level for a drinking water source and no dose-response parameters are available to quantitatively address exposure to this chemical.

Mercury was the only surface water chemical which exceeded the state AWQC for human health, but was not retained as a COC in the baseline human health risk assessment. The maximum detections of this chemical in unfiltered and filtered surface water samples were less than the risk-based concentration for tap water ingestion and only slightly exceeded the state AWQC for consumption of organisms and/or water and organisms.

E.3.5 Recommendations

It is recommended that the site proceed to a Feasibility Study (FS) to evaluate a "limited action" effort, consisting of a groundwater monitoring program and possibly access/use restrictions. This recommendation for the Area A Wetland is based on the following information:

- Little evidence of surface water or groundwater contamination is present at the site. Only one organic chemical (tetrachloroethene) was detected in surface water at the site. Carbon disulfide ($2 \mu\text{g/L}$ in one sample) and xylenes ($1 \mu\text{g/L}$ in one sample) were the only volatile organics detected in groundwater samples. Low concentrations of semivolatile organic compounds [the highest concentration detected was $30.5 \mu\text{g/L}$ of bis(2-ethylhexyl)phthalate] were detected in groundwater.
- Although significant concentrations of PAHs, pesticides, and one PCB were detected in soil and sediment samples, these compounds are considered somewhat immobile in the environment. Several volatile organic compounds were detected at relatively low concentrations in the soil and

sediment. It is also noted that elevated concentrations of PAHs were detected in sample location 2WSD9. The location of this sample suggests that the Area A Weapons Center may represent the source of contamination. This finding will be discussed further in Chapter 8, Site 20 - Area A Weapons Center.

- The human health risk assessment concluded that carcinogenic risks were less than $1E-6$ or within the USEPA target risk range of $1E-6$ to $1E-4$. Noncarcinogenic risks were below the USEPA acceptable level of one for the CTE. However, the RME construction worker may experience toxic effects since the cumulative HI exceeded one. The human health risk assessment assumed that the construction worker would come in direct contact with soil and groundwater at the site. It is required (per OSHA standards for work on hazardous waste sites) that Health and Safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker to acceptable levels. Furthermore, the majority of the construction worker risk is attributable to the presence of manganese in groundwater which is a commonly detected inorganic.
- The Area A Wetland is dominated by *Phragmites* which does not provide a food source to ecological species. Although the Area A Wetland provides a good habitat for ecological receptors and potential risks exist for aquatic and terrestrial receptors; the calculations were performed using highly conservative estimates. Furthermore, obvious ecological impacts have not been observed to date.

The exact extent of the "limited action" alternative will be developed during the FS phase of this project. Groundwater monitoring will likely be the major process option in any limited action remedial alternative developed for the Area A Wetland; however, access/use restrictions on certain media at the site may be used to augment monitoring in certain limited action plans. The FS will evaluate "limited action" alternatives (for instance, monitoring with and without access/use restrictions) as well as a "no action" alternative and one or more "active remediation" alternatives. A "limited action" alternative may only be implemented at the Area A Wetland if it compares favorably in the feasibility study to other "no action" and "active remediation" alternatives.

E.4 AREA A WEAPONS CENTER

This section presents a summary of major findings of the Phase II RI for the Area A Weapons Center. A summary of the nature and extent of contamination is provided in Section E.4.1. Sections E.4.2 and E.4.3

summarize the baseline human health risk assessment and ecological risk assessment for the site respectively. Section E.4.4 summarizes the comparison of site data to state standards and Section E.4.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.4.1 Nature and Extent of Contamination

Organic and inorganic chemicals were detected in the various media samples at the Area A Weapons Center. The most prevalent chemicals detected included phthalate esters and PAHs. Volatile organic chemicals were also detected, but the concentrations were typically quite low. The highest detection of a volatile organic chemical in soil was 690 $\mu\text{g/kg}$ (acetone), with most other volatile organic concentrations being much lower. By contrast, PAHs were detected at concentrations ranging as high as 5,700 $\mu\text{g/kg}$ in the soil matrix.

Analytical results for groundwater samples indicate that little impact on groundwater has occurred as a result of surficial contamination at the site. Few organic chemicals were detected in groundwater, and all concentrations were 12 $\mu\text{g/L}$ or less. However, a few metals (most notably manganese at a maximum concentration of 6,540 $\mu\text{g/L}$) were detected at elevated concentrations in the groundwater samples.

Similarly, surface water results indicate that little impact on surface water quality has occurred. The only organic chemicals detected in surface water were di-n-octylphthalate and butylbenzylphthalate (both 2 $\mu\text{g/L}$ or less).

Sediment analytical results are consistent with those for the soil samples; PAHs were detected in sediment samples from the three drainage areas at concentrations ranging as high as 6,900 $\mu\text{g/kg}$ (fluoranthene and pyrene). Other organics detected in sediment samples included pesticides (e.g., endrin aldehyde at 140 $\mu\text{g/kg}$), trichloroethene (22 $\mu\text{g/kg}$), and methylene chloride (22 $\mu\text{g/kg}$). The most pervasive and concentrated chemicals detected in solid matrices at the site were PAHs, which are ubiquitous chemicals often associated with the use of asphalt paving materials or automobile or stack emissions. Numerous metals were also detected in sediment samples, with elevated concentrations of a few metals (most notably cadmium, lead and manganese).

Overall, the analytical data indicate that minimal contamination other than that which is often found in urban and industrial areas exists at the site. Furthermore, the data for surface water and groundwater samples indicate that the site is not acting as a source of contamination for downstream or downgradient locations.

E.4.2 Baseline Human Health Risk Assessment

Three potential receptor groups were considered for the Area A Weapons Center based on current and projected future land use. These include full-time employees, construction workers, and potential future residents. Both noncarcinogenic and carcinogenic risk estimates were generated for these receptor groups.

Noncarcinogenic risk estimates for the full-time employee and the construction worker for the CTE were less than one. Noncarcinogenic risks for the RME construction worker and potential future residents (CTE and RME) exceed the USEPA acceptable level of one. Future residents are assumed to use groundwater as a potable water supply, whereas construction workers are exposed to groundwater via dermal contact only. The majority of the noncarcinogenic risks are associated with exposure to manganese in groundwater, which is a commonly found naturally occurring metal. Arsenic and thallium are additional noncarcinogens of concern for the future resident exposed to groundwater. Incremental lifetime cancer risks except for the RME future resident, were less than $1\text{E-}6$ or within the USEPA's acceptable target risk range of $1\text{E-}4$ to $1\text{E-}6$. Carcinogenic risks for future residents are primarily attributable to the presence of dibenz(a,h)anthracene and arsenic.

E.4.3 Ecological Risk Assessment

As described in Section 8.7, the Area A Weapons Center currently represents an undesirable wildlife habitat; the site is well-developed and characterized by buildings, weapons storage bunkers, paved areas between the bunkers and maintained lawns. Drainage ditches in this area typically do not contain standing water for any extended period of time and currently do not support an aquatic community. However, the Area A Weapons Center does border areas that do represent a potential wildlife habitat. Using the conservative assumptions discussed in Section 3.4.4.2, both the maximum and average concentrations of contaminants detected in surface water, sediment, and surface soils collected from this site exceeded benchmark values protective of various aquatic and terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact aquatic biota, terrestrial vegetation, and terrestrial vertebrates if present. However, none of the chemicals detected at this site represent a risk to soil invertebrates.

However, it should be noted that the primary concern with respect to soil invertebrates and heavy metal contaminants is not the direct impact of these contaminants, but the fact that soil invertebrates, particularly earthworms, can tolerate these contaminants in their tissues. This is particularly true of cadmium; these soil invertebrates are known to greatly concentrate cadmium relative to soil (Beyer, 1990). Therefore, although these results suggest that soil invertebrates are not being adversely impacted by soil contaminants detected

at this location, it is possible that predators feeding on these organisms may be exposed to soil contaminants concentrated in their tissue.

The results of the ecological risk assessment indicate that with the exception of soil invertebrates, organisms using this area would potentially be at risk, assuming that the Area A Weapons Center provided habitat and forage for terrestrial receptors. However, because of the current conditions associated with this site, actual risks to ecological receptors are likely to be much less than those calculated for this area. For instance, the results of this conservative assessment indicated that terrestrial vegetation would be adversely impacted. However, the site does support a well-established lawn. Areas bordering the Area A Weapons Center (e.g., the nearby upland coniferous/deciduous forest) do represent a desirable habitat for wildlife. Organisms inhabiting this area may come in contact with surface water, sediment, or soil while moving through the area to forage in the nearby Area A Wetland or upland areas. While potentially exposed to soil contaminants, this exposure is much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby reducing the actual ecological risks associated with this site. When the current site conditions are factored into this evaluation, it is concluded that the Area A Weapons Center represents little potential risk to ecological receptors that might utilize this area. However, it should be noted that, due to potential transport from this site, contaminants associated with the Area A Weapons Center may be impacting organisms inhabiting the Area A Wetland.

E.4.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 8.8. All soil chemicals reported at maxima in excess of Connecticut remediation standards for pollutant mobility were identified as COCs in the baseline human health risk assessment.

For groundwater, almost all of the chemicals found at concentrations exceeding state standards were retained as COCs in the baseline human health risk assessment, except for bis(2-ethylhexyl)phthalate and sodium. No dose-response parameters are available for sodium, and it should be noted that the applicable state standard for this chemical is a Notification Level for a drinking water source. Although the maximum detection of bis(2-ethylhexyl)phthalate exceeded the groundwater protection criteria, the maximum concentration of this chemical was less than the risk-based COC screening level.

Surface water and sediment data were also compared to state standards. With respect to state AWQC for human health, only arsenic was found at a maximum exceeding the applicable criteria. This chemical was identified as a COC for surface water in the human health risk assessment. For sediment, benzo(k)fluoranthene was reported at a maxima exceeding the pollutant mobility criteria, but was not

retained as a COC in the human health risk assessment. Although the maximum of this chemical was less than the risk-based COC screening criteria for soil ingestion, this chemical may migrate to groundwater and potentially impact water quality.

E.4.5 Recommendations

It is recommended that this site proceed to a Feasibility Study (FS) to evaluate a "limited action" effort consisting of a groundwater monitoring program and possibly access/use restrictions. This recommendation for the Area A Weapons Center is based on the following supporting information:

- The potential exists for contaminants to migrate from the site to the Area A Wetland and impact ecological receptors. Although notable levels of contamination have been detected in soils and sediment at the site, the most prevalent contaminants detected included phthalate esters and PAHs, which are relatively less soluble compounds, and are therefore, less mobile. Volatile organic chemicals were detected at low concentrations, with the maximum detected volatile organic concentration in soil of 690 $\mu\text{g/kg}$ (acetone in one sample). Elevated concentrations of PAHs were detected in one of the Area A Wetland sediment samples (2WSD9) which was located in a drainage ditch exiting the Area A Weapons Center. Although this suggests that the Weapons Center is a contaminant source, it is believed that the contamination is limited in extent. This is supported by the fact that Weapons Center sediment sample 2WCSD11, which is located immediately adjacent to 2WSD9, only exhibited marginal concentrations of PAHs.
- Analytical results indicate minimal contamination of surface water and groundwater. The only organic compounds detected in surface water were di-n-octylphthalate and butylbenzylphthalate (both at concentrations of 2 $\mu\text{g/L}$ or less). Few organic compounds were detected in groundwater samples at the site, and all concentrations were less than 12 $\mu\text{g/L}$. Manganese has been detected in groundwater at elevated concentrations at the site, however this finding is consistent with the frequent detection of this chemical element at numerous other sites at the facility, and in the proximate Thames River.
- Low human health risks are associated with the site, based on the current land use scenario. The noncarcinogenic risk estimates were all below the USEPA acceptable level of one for the full-time employee and the construction worker under the CTE and above one for the construction worker under the RME and potential future resident. The calculated incremental lifetime cancer risks were all less than $1\text{E-}6$ or within the USEPA acceptable target risk range of $1\text{E-}4$ to $1\text{E-}6$, for all scenarios except the RME future resident. The elevated risks to the

construction worker and future resident are primarily attributable to exposure to groundwater beneath the site. It is unlikely that the future residential and construction worker scenarios that were evaluated would occur under future land use. It is required (per OSHA standards for work on hazardous waste sites) that health and safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker to acceptable levels. It is also unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would therefore lower the risk to USEPA acceptable levels. Furthermore, the majority of noncarcinogenic risk to the future resident and construction worker is attributable to exposure to manganese, which is a commonly found naturally occurring metal.

- The Area A Weapons Center consists of a well developed area that is characterized by buildings, bunkers, paved areas, and lawns. These features represent an undesirable wildlife habitat. Therefore, it is highly unlikely that organisms inhabiting the area around the site would spend a significant amount of time at the site. Although the ecological risk assessment concluded that chemicals at the site could adversely impact ecological receptors, the evaluation performed used highly conservative assumptions and the actual risks would be significantly lower. In addition, none of the chemicals detected at this site represent a risk to soil invertebrates. When the current site conditions are factored into this evaluation, it is concluded that the Area A Weapons Center represents little potential risk to ecological receptors.

The exact extent of the "limited action" alternative will be developed during the FS phase of this project. Groundwater monitoring will likely be the major process option in any limited action remedial alternative developed for the Area A Weapons Center; however, access/use restrictions on certain media at the site may be used to augment monitoring in certain limited action plans. The FS will evaluate "limited action" alternatives (for instance, monitoring with and without access/use restrictions) as well as a "no action" alternative and one or more "active remediation" alternatives. A "limited action" alternative may only be implemented at the Area A Wetland Site if it compares favorably in the feasibility study to other "no action" and "active remediation" alternatives.

E.5 AREA A DOWNSTREAM WATERCOURSES AND OVER BANK DISPOSAL AREA

This section presents a summary of major findings of the Phase II RI for the Area A Downstream Watercourses. A summary of the nature and extent of contamination is provided in Section E.5.1. Section E.5.2 and E.5.3 summarize the baseline human health risk assessment and the ecological risk

assessment for the site, respectively. Section E.5.4 summarizes the comparison of site data to State standards and Section E.5.5 provides recommendations regarding additional action or investigatory efforts for the site.

The Area A Downstream Watercourses and OBDA site were divided into six distinct zones. These zones were derived based on surface water drainage features for the evaluation purposes of this Phase II RI. The zones are shown on Figure 9-2 and Drawing 23 (Volume III). Zone 1 includes the Over Bank Disposal Area and OBDA Pond and follows Stream 1 which enters a storm sewer and flows west to the west side of North Lake. Zone 2 includes Lower Pond and Stream 3 and circles north and then west to the west side of North Lake. Zone 3 includes Stream 4, Upper Pond, and Stream 3 and generally parallels Triton Road to the entrance of the Torpedo Shops. Zone 4 includes North Lake. Zone 5 follows Stream 5 from the entrance of the Torpedo Shops along Triton Road through the Small Arms Range, across Shark Boulevard, and eventually reaching the Thames River. Zone 6 includes an area from the west side of North Lake along Stream 6, across Shark Boulevard, and west to Thames River.

E.5.1 Nature and Extent of Contamination

Various organic and inorganic chemicals were detected in multiple environmental media samples in the Area A Downstream Watercourses and OBDA. Multiple chemicals were detected in various water bodies, primarily in the sediment matrix, most notably in Zones 1, 2, and 3. Although many compounds were detected, those that are most concentrated include 4,4'-DDT and its metabolites. In addition, the concentrations of some metals in the sediments (e.g., arsenic and lead) were also high. Concentrations of several metals, particularly boron, iron, and manganese, were higher in surface water samples collected during the ecological study than in associated reference samples. Finally, organic chemicals were sporadically detected in groundwater; most notably, vinyl chloride was detected in one well at a concentration of 130 $\mu\text{g/L}$. The source of this vinyl chloride is believed to be associated with historical waste disposal from the abandoned Torpedo Shops leach beds sewer disposal system.

E.5.2 Baseline Human Health Risk Assessment

Three potential receptor groups were considered for the baseline risk assessment: older child trespassers and construction workers at Zones 1, 2, 3, 5, and 6 and adult and child recreational users at North Lake (Zone 4). All noncarcinogenic risks for recreational users at North Lake were below the USEPA acceptable level of one and all cancer risks were within the USEPA acceptable target risk range of $1\text{E-}6$ to $1\text{E-}4$. Noncarcinogenic risks for RME older child trespasser at Zones 1 and 2 exceeded the USEPA acceptable level of one. Noncarcinogenic risks for the RME construction worker exceeded one for all zones. All

carcinogenic risks were either within the USEPA acceptable target risk range of $1E-6$ to $1E-4$ or less than $1E-6$.

Noncarcinogenic risks associated with dermal exposure to groundwater for the construction worker are attributed to detections of antimony and manganese; carcinogenic risks for this exposure route are a result of exposure to vinyl chloride and 1,1,2,2-tetrachloroethane. In general, those chemicals contributing significantly to the carcinogenic risks associated with soil/sediment for most zones include 4,4'-DDD, 4,4'-DDT, arsenic, and beryllium. 4,4'-DDT contributes the most to the overall carcinogenic risks for surface water for Zones 1, 2, and 3. Although lead was identified as a chemical of concern, the calculated blood lead level associated with this chemical was below the published level of concern.

E.5.3 Ecological Risk Assessment

When the maximum and average concentrations of chemicals detected in surface water and sediments were compared to benchmark values protective of aquatic receptors, HQs greater than 1.0 were calculated for all of the streams and ponds present in the Area A Downstream Watercourses and OBDA. The pesticide, 4,4'-DDT and DDT residues (DDTR) often accounted for the majority of the potential risk to these receptors. Heavy metals in the sediments also contributed to risk, but generally not to the same degree as that associated with the presence of DDT and DDTR.

The results of macroinvertebrate studies conducted as part of the Phase II RI supplemental ecological investigations demonstrated that the communities in these systems were generally characteristic of those associated with small, ephemeral, first-order systems. The streams in the Area A Downstream Watercourses and OBDA supported few taxa and generally exhibited low numbers and limited diversity of individuals. These results suggest that conditions associated with the Area A Downstream Watercourses and OBDA streams were suppressing the benthic community.

Comparisons between the macroinvertebrate community in the Upper Pond, OBDA Pond, and Lower Pond and the reference ponds also demonstrated that these communities were stressed. The differences between the Lower Pond macroinvertebrate community and the community in Niantic Pond (reference location for Lower Pond) were marked. In fact, of the waterbodies examined in the Area A Downstream Watercourses and OBDA, the macroinvertebrate community present in the Lower Pond exhibited the greatest indication of stress. The results of the macroinvertebrate survey conducted in 1995 were generally consistent with those documented in the study performed in support of the Focused Feasibility Study; the Area A Downstream Watercourses and OBDA macroinvertebrate community exhibited indications of adverse impacts as compared to the communities present in the reference locations.

Toxicity tests were also performed to document the toxicity of sediments collected from the Area A Downstream Watercourses and OBDA waterbodies. Frog embryos and two species of macroinvertebrates were exposed to sediments collected in 1995. The results of these tests demonstrated that exposure to sediments collected from the Area A Downstream Watercourses and OBDA waterbodies adversely impacted both of the macroinvertebrate species (i.e., little or no survival). These results were similar to those studies conducted in support of the Focused Feasibility Study which indicated that survival among macroinvertebrate test organisms exposed to sediments collected from the three Area A Downstream Watercourses and OBDA ponds was significantly reduced. On the other hand, impacts to frog embryos exposed to sediments collected in 1995 from all Area A Downstream Watercourses and OBDA locations except the OBDA and Lower Ponds were not significantly different from those exhibited by embryos exposed to reference sediments. These results, coupled with the results of the macroinvertebrate survey and the concentrations of chemicals detected in surface and sediment samples, indicated that the Area A Downstream Watercourses and OBDA aquatic macroinvertebrates are at risk.

Comparison of surface soil (0' - 2') contaminant levels to phytotoxic benchmarks determined that no chemicals were present in concentrations that resulted in HQ values greater than 1.0. In addition, none of the chemicals detected in surface soils were present in concentrations in excess of benchmark values protective of soil invertebrates.

This ecological risk assessment also assessed the potential risks to terrestrial vertebrate receptors. Both maximum and average concentrations of chemicals resulted in HQs greater than 1.0. With few exceptions, the primary means of exposure to contaminants associated with the Area A Downstream Watercourses and OBDA was through the ingestion of contaminated prey (e.g., soil invertebrates or frogs). Exposure to contaminants in drinking water or through the incidental ingestion of soil or sediments represented little potential risk to these receptors.

These results indicate that, of the various receptors examined in this ecological risk assessment, aquatic macroinvertebrates were being most adversely impacted by the contaminants detected in surface water and sediments associated with the streams and ponds in the Area A Downstream Watercourses and OBDA. Based on the conservative assumptions summarized in Section 3.4, indirect impacts to vertebrate receptors as a result of exposure to chemicals through the food chain is also of concern. However, while reducing media-specific concentrations of chemicals should lessen the impacts to macroinvertebrate receptors, the physical nature of these small, ephemeral systems will ultimately limit the size and diversity of the macroinvertebrate population that can be supported by the Area A Downstream Watercourses and OBDA waterbodies.

E.5.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 9.8. Although not selected as COCs in the baseline human health risk assessment, alpha-chlordane (Zone 1), gamma-chlordane (Zones 1 and 3) and heptachlor (Zones 1 and 3) were detected in site soil/sediment samples at maximum concentrations exceeding the Connecticut remediation standards. While these chemicals may migrate to groundwater and potentially impact water quality, reported maxima were less than the risk-based COC screening levels for soil ingestion.

For groundwater, which was evaluated as one entity for the entire site, several exceedances of state standards were observed in the unfiltered and filtered samples. All of these chemicals, except sodium and zinc, were retained as a COC in the baseline human health risk assessment. No dose-response parameters are available to quantitatively evaluate exposure to sodium. It should also be noted that the applicable Connecticut standard for this chemical is a Notification Level for a drinking water source. Although the surface water protection criteria was exceeded for zinc in groundwater, the associated maximum detection of this analyte was less than the risk-based COC screening criteria for ingestion of tap water.

Surface water data were compared to Connecticut Water Quality Standards for human health. 4,4'-DDT (Zones 5 and 6) and mercury (Zones 1 and 6) were detected at maxima in excess of these state standards, but were not identified as COCs in the baseline human health risk assessment. These surface water chemicals were not quantitatively evaluated in the risk assessment since maximum detections were less than the risk-based COC screening levels for ingestion of tap water.

E.5.5 Recommendations

It is recommended that the Feasibility Study that was prepared for this site be revisited to focus on pesticide contamination in soil and sediments associated with Zones 1, 2, and 3. Data from this Phase II RI Report can be used to define cleanup criteria for the site based on both human health and ecological risks. Additional sampling will also be required to better delineate the extent of pesticide contamination and to determine the origin of volatile organic contamination in groundwater. Finally, it is recommended that the debris associated with the OBDA be removed. This group of recommendations is supported by the following information:

- Notable detections of pesticides exist in soils and sediments at the site. Soil concentrations of pesticides range as high as 1,400,000 $\mu\text{g/kg}$ (4,4'-DDT) and sediment pesticide concentrations range as high as 850,000 $\mu\text{g/kg}$ (4,4'-DDD).

- Organic compounds were detected in groundwater at the site and the source is unknown. Well 2DMW29S detected vinyl chloride as high as 130 $\mu\text{g/L}$. Further investigation of the origin of this contamination is needed. It is possible that the contamination is derived from the abandoned Torpedo shops leach field sewer system which is located in the vicinity of this well. Monitoring of the groundwater in other wells located at this site are also needed.
- The human health risk assessment concluded that noncarcinogenic risks (hazard indices) exceeded the USEPA acceptable level of one for the RME older child trespasser for Zones 1 and 2 and the RME construction worker for all zones. Lifetime incremental cancer risks for all zones were either within the USEPA target risk range of $1\text{E-}6$ to $1\text{E-}4$ or less than $1\text{E-}6$. The noncarcinogenic risks for the construction worker are partially attributable to exposure to manganese in groundwater beneath the site. Manganese is a commonly found naturally occurring metal. It should be noted that it is required (per OSHA standards for work on hazardous waste sites) that Health and Safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these measures would lower the risk to the construction worker to acceptable levels.
- The ecological risk assessment indicated that the concentrations of DDTR represent a potential risk to aquatic organisms. The ecological risk assessment concluded that aquatic biota (benthic macroinvertebrates) present in the Area A Downstream Watercourses and OBDA are at risk as a result of exposure to contaminants present in surface water and sediments. Vertebrate receptors may also be at risk as a result of indirect exposure to site contaminants through consumption of prey. Although the physical nature of these small ephemeral systems ultimately limits the size and diversity of the aquatic community supported by Area A Downstream Watercourses and OBDA waterbodies, the presence of contaminants in surface water and sediments, particularly organic contaminants, and the apparent potential for continued contaminant migration, represent long term potential risks to aquatic biota.

It is also recommended that no further action is required for North Lake for the following reasons:

- No organic compounds were detected in surface water samples collected during the Phase I or II RIs. Organic compounds were detected in surface water samples collected by the Navy, however, the concentrations were relatively low. Beach sand comprises the sediment at North Lake.

- There does not appear to be direct hydraulic connection between North Lake surface water and adjacent groundwater or surface water at the site. Surface water from the Area A Downstream watercourses is diverted around North Lake.
- North Lake is refilled every year with potable water.
- All noncarcinogenic risks for recreational users were below the USEPA acceptable level of one and all carcinogenic risks were within the USEPA acceptable target risk range of $1E-6$ to $1E-4$. Therefore, no unacceptable risks are associated with recreational exposure at North Lake.

The recommended focused feasibility study report covering site soil, sediments and surface water has been submitted as a revised draft (B&R Environmental, December 1996). This document recommends further work at the site including additional sampling of soils and sediments to confirm the extent of DDTR contamination and to verify the existence of and define the extent of dioxin contamination at the site. In addition, the recommended removal of debris associated with the OBDA has been completed.

E.6 RUBBLE FILL AREA AT BUNKER A-86

This section presents a summary of major findings of the Phase II RI for the Rubble Fill Area. A summary of the nature and extent of contamination is provided in Section E.6.1. Sections E.6.2 and E.6.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.6.4 summarizes the comparison of site data to State standards and Section E.6.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.6.1 Nature and Extent of Contamination

Multiple organic and inorganic chemicals were detected in soil and sediment samples collected in and around the Rubble Fill Area. Groundwater and surface water samples were found to be relatively pristine in spite of the presence of contamination in the solid matrices. This is primarily attributable to the sorptive nature of the chemicals found at the highest concentrations in the Rubble Fill Area, which included metals, phthalate esters, and polynuclear aromatic hydrocarbons. Based on the detection of high concentrations of such chemicals in the sediment matrix (as well as the surface soil) it appears that the Rubble Fill Area is contributing to downslope sediment contamination. However, since the swale at the site receives stormwater from various locations along Wahoo Avenue, it is possible that other sources (e.g., asphalt roadways) could account for some, of the downstream contamination. It should be noted that surface water

flows in the site ditch and swale during, and immediately after, precipitation events. Therefore, transport of contaminants via surface water erosion would exist only during these circumstances.

E.6.2 Baseline Human Health Risk Assessment

The baseline risk assessment for the Rubble Fill Area included consideration of two primary receptor groups: construction workers and older child trespassers. Noncarcinogenic risk estimates were below the USEPA acceptable level of one for the older child trespasser under the RME and CTE and the construction worker under the CTE. Although the noncarcinogenic risk estimate for the RME construction worker slightly exceeds one, no adverse effects are anticipated for this receptor since the major contributors to the cumulative hazards do not impact the same target organs. Incremental lifetime cancer risks for both receptors are within the USEPA's acceptable target risk range of $1E-6$ to $1E-4$ under both exposure scenarios. It is therefore concluded that the site poses little risk to human health.

E.6.3 Ecological Risk Assessment

The 25 feet by 60 feet Rubble Fill Area currently provides limited habitat for ecological receptors. However, habitat bordering this site is more likely to support ecological receptors. Contaminants were detected in samples collected from both within and outside the 25 feet by 60 feet area designated as the Rubble Fill Area. Using the conservative assumptions discussed in Section 3.4.4.2, the maximum concentrations of chemicals detected in surface soils (0 to 2 feet) were compared to benchmark values protective of various terrestrial ecological receptors. The results of these comparisons indicate that detected chemicals could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. When the risks associated with the average concentrations in surface soil were evaluated, risks to these receptors were reduced, but still exceeded 1.0. A number of the contaminants representing a risk to ecological receptors were collected from areas outside the Area A Rubble Fill boundaries. These results indicate that because of the current site conditions within the Area A Rubble Fill ecological receptors are unlikely to utilize the area and the risks to these receptors are lower than those calculated as part of this investigation. However, because a number of contaminants (e.g., arsenic and PAHs) representing a potential risk to ecological receptors were detected outside of the Rubble Fill boundaries in ecologically desirable habitats, it is possible that ecological receptors are at risk. Until the extent of the contamination at this site is better defined, the potential risks to ecological receptors cannot be determined.

E.6.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 10.8. Although not retained as COCs in the baseline human health risk assessment, pyrene and dieldrin in soil were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. Although these compounds may migrate to groundwater and potentially impact water quality, maximum detections were less than risk-based COC screening levels for soil ingestion.

For groundwater, sodium was the only chemical which exceeded state standards, but was not selected as a COC in the baseline human health risk assessment. It should be noted that the applicable state standard for sodium is a Notification Level for a drinking water source and no dose-response parameters are available for this chemical.

Surface water and sediment samples were also collected at site. Minimal exceedances of state AWQC for human health were noted for surface water. All of these chemicals were retained as COCs in the baseline human health risk assessment. In sediments, benzo(k)fluoranthene and butylbenzylphthalate were not selected as COCs in the baseline human health risk assessment, but were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. Although these compounds may migrate to groundwater and potentially impact water quality, maximum detections were less than risk-based COC screening levels for soil ingestion.

E.6.5 Recommendations

It is recommended that further characterization be conducted at the Rubble Fill Area at Bunker A-86 to determine the nature and extent of semivolatiles and metals in soil and sediment. Focus should be devoted toward linking contamination detected in the rubble fill area soils with contamination detected in the sediment of the adjacent ditch to the west and the downslope swale to the northwest. This recommendation is based on the following information:

- The sediment sampling results indicate the site may be contributing to the downslope presence of PAHs and metals. Sediment contamination has been detected in sample 4SD2 which was collected at the confluence of the west ditch and the northwest swale. The northwest swale receives stormwater runoff from other areas located along Wahoo Avenue and it is possible that some of the contamination detected in 4SD2 is derived from these sources. Additional sampling is required to determine the contribution of site related sediment contamination.

- The extent of soil contamination is unknown. Several of the soil samples which were located along the perimeter of the rubble fill area detected significant levels of PAHs and metals. Additional perimeter sampling is required to define the extent of soil contamination.

Although contamination has been detected in soil and sediment at the site, and it requires further characterization, it should be noted that based on the information collected during the Phase I and II RIs, relatively low human health and ecological risks are present at the site. This conclusion is supported by the following information:

- The human health risk assessment concluded that noncancer risk estimates below the USEPA acceptable level of 1.0 for all receptor groups except the RME construction worker. Incremental cancer risks were all within the USEPA's acceptable target risk range of $1E-6$ to $1E-4$ for all receptor groups.
- Although the ecological risk assessment concluded that chemicals at the site could adversely impact ecological receptors, the evaluation performed used highly conservative assumptions and the actual risks would be significantly lower.

An upgradient groundwater and surface water interceptor trench is planned to be installed during the construction of the Area A Landfill Cap. Excavation of the Rubble Fill Area at Bunker A86 will be required to maintain slope requirements of the landfill cap. The Navy intends to remove the Rubble Fill Area as part of a time-critical removal action. Confirmation sampling will be conducted to ensure that all potentially contaminated material has been removed, and to serve as the recommended further characterization of the site.

E.7 DEFENSE REUTILIZATION AND MARKETING OFFICE

This section presents a summary of major findings of the investigations for the DRMO. A summary of the nature and extent of contamination is provided in Section E.7.1. Sections E.7.2 and E.7.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.7.4 summarizes the comparison of site data to State standards and Section E.7.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.7.1 Nature and Extent of Contamination

Relatively high concentrations of multiple organic and inorganic chemicals were detected in the soil matrix at the DRMO. Organic chemicals detected at high concentrations include various halogenated aliphatic compounds, polynuclear aromatic hydrocarbons, phthalate esters, Aroclor-1254, and Aroclor-1260. Most of these classes of chemicals are relatively water insoluble (with the exception of the volatile organics). Consequently, only low concentrations of these compounds were detected in groundwater samples collected at the site. The maximum observed concentration of the water insoluble organic chemicals in groundwater was 20 $\mu\text{g/L}$ (bis(2-ethylhexyl)phthalate).

In spite of the fact that relatively high concentrations of some volatile organics were detected in the subsurface soil, it does not appear that substantial impact on the groundwater has occurred to date. For example, although halogenated organics such as 1,2-dichloroethene and trichloroethene were detected in soil samples at concentrations ranging to 16,000 $\mu\text{g/kg}$ and 7,100 $\mu\text{g/kg}$, respectively, no evidence of substantial impact on groundwater quality has been noted. The maximum concentration of a halogenated chemical in groundwater samples was 8 $\mu\text{g/L}$ (1,2-dichloroethene and trichloroethene). Even though groundwater monitoring wells are located less than 100 feet downgradient of the volatile organic contamination area, little impact has been noted; no more than 8 $\mu\text{g/L}$ total volatiles were detected in groundwater samples from these wells. The absence of halogenated compounds in groundwater is probably a function of the salinity of the groundwater in this area (due to the proximity to the Thames River) that effectively reduces solubility of organic compounds.

In addition to the various organic chemicals detected in soil at the DRMO, relatively high concentrations of lead still remain in soil after the time-critical removal action was conducted. Surface and subsurface soil lead concentrations ranged as high as 4,980 mg/kg and 2,140 mg/kg , respectively. In spite of the high lead concentrations in soil, only limited evidence of lead migration to the water table is evidenced by the groundwater analytical results. Although lead was detected as high as 52.7 $\mu\text{g/L}$ in one unfiltered sample, lead concentrations in filtered groundwater samples ranged no higher than 2.4 $\mu\text{g/L}$. Furthermore, the site is now capped which will effectively eliminate precipitation infiltration to the groundwater.

E.7.2 Baseline Human Health Risk Assessment

Multiple potential receptor groups were considered for the DRMO including an older child trespasser, construction worker, future residents, and full-time employees. Noncarcinogenic risks were all below the USEPA acceptable limit of one for the CTE, but exceeded one under the RME for all receptors. PCBs in

soil are the primary contributors to the RME noncarcinogenic risks. Incremental lifetime cancer risks were either less than $1\text{E-}6$ or within the USEPA's acceptable target risk range of $1\text{E-}6$ to $1\text{E-}4$. Additionally, application of the IEUBK model for lead uptake from soil resulted in blood lead levels below the level of concern.

It should be noted that the area is now paved with an asphalt cap which effectively reduces the risk to human health. With the exceptions of the surface soil sample collected from test boring GTB23, located at the northern end of the site, and the surface soil sample GSS4, collected near the southeast end of the site, all surface soil samples represent soils which are beneath the asphalt cap or beneath other paved surface.

E.7.3 Ecological Risk Assessment

The DRMO is a well-developed area located near the Thames River and is characterized by high human traffic. This location provides neither cover or forage for wildlife receptors. In addition, no nearby areas represent suitable wildlife habitat. Despite these conditions, potential risks to ecological receptors were evaluated using the conservative assumptions discussed in Section 3.4.4.2. Both the maximum and average chemical concentrations in surface soils were compared to benchmark values protective of various terrestrial ecological receptors. Results of these comparisons indicate that terrestrial receptors exposed to both the maximum and average concentrations are potentially at risk. However, because of the current conditions associated with this site (area is paved with an asphalt cap), actual risks to ecological receptors are likely to be much less than those calculated for this area. It is unlikely that ecological receptors will utilize this area, essentially eliminating the possibility that these receptors will be exposed to these chemicals. Furthermore, the presence of the cap makes it impossible for ecological receptors to contact soil at the site. When the current site conditions are factored into this evaluation, it is concluded that the DRMO represents little potential risk to ecological receptors.

E.7.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 9.8. Although 1,2-dichloroethane, 1,2-dichloroethene (total), trichloroethene, vinyl chloride, and benzo(k)fluoranthene were not retained as COCs for soil in the baseline human health risk assessment, they were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. While maximum detections of these chemicals were less than the risk-based COC screening levels for soil ingestion, they may migrate to groundwater and potentially impact water quality.

For groundwater, most of the chemicals found at concentrations exceeding state standards were retained as COCs in the baseline human health risk assessment. Sodium and zinc were not identified as COCs. No dose-response parameters are available for sodium. It should be noted that although zinc was reported at a concentration in excess of the surface water protection criteria for groundwater, the reported maximum concentration was less than the risk-based COC screening level for tap water ingestion.

Surface water data were also compared to state standards. No exceedances were observed with respect to the state AWQC for human health.

E.7.5 Recommendations

It is recommended that a feasibility study (FS) be completed for this site and a "limited action" alternative including monitoring and access/use restrictions be evaluated in the DRMO FS. Groundwater monitoring will be required to verify that significant contamination is not leaching to the groundwater or to the Thames River. If it is found that significant migration is occurring from the site to the Thames River, additional monitoring including surface water and sediment sampling in the Thames River will be conducted for the purpose of evaluating the need for additional remedial actions. This recommendation is supported by the following information.

- A time-critical removal action has been conducted at this site which included removal of 4,700 tons of contaminated soil to a maximum depth of 3 feet below the ground surface. The majority of contamination in the soil has been removed and the area has been capped.
- The groundwater is not significantly affected at the site. Although halogenated organics such as 1,2-dichloroethene and trichloroethene were detected in isolated soil samples at concentrations ranging to 16,000 and 7,100 $\mu\text{g}/\text{kg}$, respectively, the maximum concentrations in groundwater monitoring wells less than 100 feet downgradient of the soil detections yielded 8 $\mu\text{g}/\text{L}$ for each of these constituents. Groundwater monitoring is required, however to provide long-term confirmation that contamination has not migrated through the soil, into the groundwater, and ultimately discharging to the Thames River. Groundwater monitoring is planned as part of post-closure associated with the DRMO cap. The addition of the DRMO cap will greatly reduce precipitation infiltration which will have an effect on the leaching of contaminants to the groundwater from the relatively thin (less than 5 feet) vadose zone soils beneath the site.

- Relatively low human health risks are associated with the DRMO. Noncarcinogenic risks are all below the USEPA acceptable limit of one with the exception of the RME for all receptors (older child trespasser, construction worker, future resident, and full-time employee). All lifetime incremental cancer risks were either less than $1E-6$ or within the USEPA acceptable target risk range of $1E-6$ to $1E-4$. It should be noted that the risk scenarios assumed direct exposure to soil and groundwater at the DRMO. Exposure to soil at the DRMO is limited due to the presence of the asphalt cap with the exception of the construction worker which assumes deliberate excavation and contact. However, it is required (per OSHA standards for work on hazardous waste sites) that health and safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker to acceptable levels. The future residential scenario assumed direct contact and ingestion of groundwater beneath the site. It is unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would therefore lower the risk to the future resident to USEPA acceptable levels.
- Ecological risks are low for the DRMO. The ecological risk assessment concluded that exposure to surface soils could adversely impact terrestrial ecological receptors using highly conservative estimates. However, the DRMO does not provide a suitable ecological habitat due to the presence of paving, buildings, etc., and the asphalt cap effectively eliminates direct soil contact. It is therefore concluded that the DRMO represents little potential risk to ecological receptors.
- Since the DRMO is located adjacent to the shore of the Thames River, it is possible that contaminant transport from the DRMO could affect ecological receptors in the river. Except for samples collected in the Thames River itself, no offsite or downgradient samples were collected to evaluate contaminant transport from the DRMO.

A feasibility study (FS) has been conducted in response to the previously mentioned recommendation. The findings of the FS are included in "Feasibility Study for DRMO, BRE, February 1997." The FS evaluated several remedial alternatives including a limited action consisting of institutional controls and monitoring. A preferred remedial alternative is pending and will be documented in the record of decision for the site.

E.8 TORPEDO SHOPS

This section presents a summary of major findings of the investigations for the Torpedo Shops. A summary of the nature and extent of contamination is provided in Section E.8.1. Sections E.8.2 and E.8.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.8.4 summarizes the comparison of site data to state standards and Section E.8.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.8.1 Nature and Extent of Contamination

Minimal environmental contamination was detected in each of the matrices sampled at the Torpedo Shops site. Samples were obtained of soil, groundwater, surface water, and sediment. Although various organic and inorganic chemicals were detected, the concentrations were typically much lower than those found at other NSB-NLON sites.

Examples of maximum detected concentrations in the soil matrix include methylene chloride (420 $\mu\text{g/kg}$), diethylphthalate (14,000 $\mu\text{g/kg}$ in one sample), phenanthrene (4,300 $\mu\text{g/kg}$), endosulfan sulfate (35 $\mu\text{g/kg}$) and TPH (386 mg/kg). A variety of organic contamination has also been detected in soil samples collected in the vicinity of the abandoned leach fields which indicates impacts in these areas. It is known that a variety of liquid wastes have been historically dumped in the drains which lead to the leach beds. This practice was stopped when sanitary sewers were installed in 1983.

Although several organic chemicals were detected in groundwater at the site, these detections are not considered indicative of a pervasive and persistent groundwater problem. For example, although volatile organics were detected at concentrations ranging as high as 42 $\mu\text{g/L}$ during the Phase I RI (1,1,1-trichloroethane), 4-methyl-2-pentanone was detected in one sample at 21 $\mu\text{g/L}$ and no other volatile organics were detected above 6 $\mu\text{g/L}$ during either of the Phase II RI sampling rounds. Low levels of sorptive organic chemicals were detected in various groundwater samples with the exception of one detection of bis(2-ethylhexyl)phthalate in one sample at a concentration of 380 $\mu\text{g/L}$. This chemical is most likely associated with entrained sediments in the sample and is not typically considered to be environmentally mobile. TPH was detected in groundwater samples collected from well 7MW8S during both rounds of the Phase II RI, with a maximum detection during Round 1 at 1,200 mg/L . It appears that some of the detections of groundwater contamination are associated with monitoring wells located in the vicinity of, or immediately downgradient of, the abandoned leach fields and sewer system.

Similarly, surface water and sediment samples collected in the vicinity of the Torpedo Shops site revealed only minimal contamination. Representative maximum concentrations for analytes detected in sediments include methylene chloride (18 $\mu\text{g/kg}$), pyrene (240 $\mu\text{g/kg}$), and 4,4'-DDD (93 $\mu\text{g/kg}$). No organic chemicals other than di-n-butylphthalate (0.6 $\mu\text{g/L}$) were detected in the two surface water samples obtained at this site.

E.8.2 Baseline Human Health Risk Assessment

The baseline human health risk assessment for the Torpedo Shops site considered the potential exposure of three receptor groups, including full-time employees, construction workers, and future potential residents. Noncarcinogenic risks exceeded the USEPA acceptable level of one for the construction worker under the RME scenario and for the future resident under both the RME and CTE scenarios. The noncarcinogenic risks for the construction worker are attributable to potential exposure to manganese in groundwater, while elevated noncarcinogenic risks for the future resident are a result of groundwater exposure to bis(2-ethylhexyl)phthalate and several metals (antimony, arsenic, manganese, and thallium). Incremental cancer risks were within the USEPA's acceptable target risk range of $1\text{E-}6$ to $1\text{E-}4$ for all of the receptor groups and exposure scenarios, except for the RME future resident. Bis(2-ethylhexyl)phthalate and arsenic contribute significantly to the carcinogenic risks for this receptor. Exposure to lead, which was identified as a potential COC for groundwater, is not expected to produce adverse health effects. TPH was identified as a potential COC for groundwater and soil at the site. Detections of TPH in these media exceeded Connecticut remediation standards.

E.8.3 Ecological Risk Assessment

The Torpedo Shops represent a well-developed area and do not provide either cover or forage for wildlife receptors. Areas near the Torpedo Shops (e.g., the wooded area to the south) do represent desirable habitat for wildlife. Organisms inhabiting this area may come in contact with on site soil while moving through the area to forage in the nearby Area A Wetland. Using the conservative assumptions discussed in Section 3.4.4.2, the maximum concentrations of chemicals detected in surface soils collected from this site were compared to benchmark values protective of various terrestrial ecological receptors. While the potential for exposures to soil does exist, actual exposure would be much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby resulting in actual ecological risks associated with this site which are significantly lower than those estimated in this assessment. When the current site conditions are factored into this evaluation, it is concluded that the Torpedo Shops represents little potential risk to ecological receptors.

E.8.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 12.8. All soil chemicals reported at concentrations in excess of state remediation standards for pollutant mobility were selected as COCs in the baseline human health risk assessment.

For groundwater, most of the chemicals found at concentrations exceeding state standards were retained as COCs in the baseline human health risk assessment. Exceptions included acenaphthylene, phenanthrene, sodium, and zinc, each of which was not identified as a COC. No dose-response parameters are available to quantitatively evaluate exposure to acenaphthylene, phenanthrene, and sodium. It should also be noted that the applicable state standard for sodium is a Notification Level for a drinking water source. The maximum detection of zinc was less than the risk-based COC screening level for tap water ingestion, therefore, this chemical was not retained as a COC.

Surface water and sediment data were also compared to state standards. Minimal exceedances of state criteria were observed for sediment, and all chemicals with maximum detections in excess of the applicable state criteria were selected as COCs in the baseline human health risk assessment. None of the chemicals detected in surface water exceeded the state human health AWQC for the consumption of organisms and/or water and organisms.

E.8.5 Recommendations

It is recommended that further characterization of the Torpedo Shops be completed. The characterization should focus on sampling and analyses in the vicinity of the abandoned sewer lines and leach fields, as well as gaining a better understanding of the construction details and integrity of the Torpedo Shops historical sewer system. It should be noted that all of the ASTs and USTs located along the southern edge of Building 325 contained No. 2 fuel oil. Therefore, all additional characterization work in this area should be deferred to, and conducted under, the UST program. Both surface and subsurface soil sampling as well as groundwater sampling including additional groundwater monitoring points are required to evaluate the nature and extent of contamination in the vicinity of the sewer system. This recommendation is supported by the following information:

- Notable detections of contamination have been observed in soil and groundwater samples collected in the vicinity of the abandoned sewer system. As discussed in Section 9, one of the wells located within the Area A Downstream Water Courses (2DMW29S) detected chlorinated solvent contamination at significant concentrations. This well is located in close proximity to the

storm sewer drain system that exits the Torpedo Shops area. Low concentrations of chlorinated solvents have also been detected in shallow wells 7MW2S and 7MW3S, and deep well 7MS3D, all located within close proximity to, and immediately downgradient of the Torpedo Shops abandoned leach fields. A variety of organic contaminants including chlorinated solvents have also been detected in soil samples collected from well boring 7MW8S which is located in the vicinity of the Torpedo Shops drainage system.

Although contamination has been detected in soil and groundwater at the site that requires further characterization in the vicinity of the Torpedo Shops sewer system, it should be noted that based on the current land use at the site and the information collected during the Phase I and II RIs, relatively low human health and ecological risks are present at the site. This conclusion is based on the following information:

- The human health risk assessment concluded that noncancer risk estimates were all below the USEPA acceptable level of one for all receptor groups except the RME construction worker and the RME and CTE future resident. Incremental cancer risks were all within the USEPA acceptable target risk range of $1E-6$ to $1E-4$ except for the RME future resident. The noncarcinogenic risks and carcinogenic risks for the construction worker and the future resident are partially attributable to exposure to manganese and arsenic in groundwater beneath the site. Manganese and arsenic are commonly found naturally occurring metals. It should be noted that it is required (per OSHA standards for work on hazardous waste sites) that Health and Safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these measures would lower the risk to the construction worker to acceptable levels. It is also unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would therefore lower the risk to the future resident to acceptable levels.
- The Torpedo Shop area consists of buildings, paved areas, and lawns which do not provide desirable habitat for terrestrial ecological receptors. Therefore, it is highly unlikely that organisms inhabiting the area around the site would spend a significant amount of time at the site. Although the ecological risk assessment concluded that chemicals at the site could adversely impact ecological receptors, the evaluation performed used highly conservative assumptions and the actual risks would be significantly lower. It is therefore concluded that the Torpedo Shops represent little risk to ecological receptors.

If the results of the focused characterization effort reveal that the nature and extent of contamination is somewhat localized, and contaminant types and concentrations are similar to that found during the Phase I and II RIs, no additional work may be required at this site. An evaluation of the data collected during the focused characterization and a comparison to the data collected during the Phase I and II RI will be required. At that time, a decision can be made regarding whether or not the site should proceed to an FS.

E.9 GOSS COVE LANDFILL

This section presents a summary of major findings of the Phase II RI for the Goss Cove Landfill Site. A summary of the nature and extent of contamination is provided in Section E.9.1. Sections E.9.2 and E.9.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.9.4 summarizes the comparison of site data to state standards and Section E.9.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.9.1 Nature and Extent of Contamination

Some of the most substantial environmental contamination detected at NSB-NLON was encountered at the former Goss Cove Landfill. Representative examples of soil contamination include the following chemicals with the respective maximum concentration shown in parentheses: acetone (23,000 $\mu\text{g/kg}$); toluene (22,000 $\mu\text{g/kg}$); ethylbenzene (69,000 $\mu\text{g/kg}$); xylenes (480,000 $\mu\text{g/kg}$); methylene chloride (38,000 $\mu\text{g/kg}$); phenol (1,600,000 $\mu\text{g/kg}$); benzo(a)anthracene (490,000 $\mu\text{g/kg}$); Aroclor-1248 (19,000 $\mu\text{g/kg}$); Aroclor-1254 (33,000 $\mu\text{g/kg}$); and lead (3,540 mg/kg). Numerous other organic chemicals were also detected in the soil matrix at this site, primarily pesticides, phthalate esters, phenols, and polynuclear aromatic hydrocarbons. Organic and inorganic chemicals were also found in groundwater samples obtained from this site. Of primary concern is the detection of tetrachloroethene (5,600 $\mu\text{g/L}$) in a groundwater sample from a deep monitoring well. It is possible that an upgradient source of groundwater contamination exists which is contributing to the tetrachloroethene contamination detected at the site. Low levels of organic constituents and high concentrations of inorganic constituents (particularly boron) were encountered in surface water samples obtained from Goss Cove. Many of the chemicals detected at high concentrations in site soil and groundwater samples were also detected in Goss Cove sediment samples. Based on the available data, it appears likely that the former Goss Cove Landfill is contributing to environmental contamination in Goss Cove. Other potential sources of contamination could include storm sewer outfalls and runoff from Military Highway.

E.9.2 Baseline Human Health Risk Assessment

The baseline human health risk assessment focused on multiple receptor groups: full-time employees, older child trespassers, future residents and construction workers. Noncarcinogenic risks for construction workers, future residents, and older trespassers under the RME exceeded the USEPA acceptable level of one. Elevated risks are attributed to tetrachloroethene in groundwater and PCBs, PAHs, and metals in soil. Although the noncarcinogenic risks for the RME older child trespasser exceeded one, no adverse effects are anticipated since chemicals contributing to the risk do not impact the same target organs. Carcinogenic risks were within the USEPA's acceptable target risk range of $1E-4$ to $1E-6$ for all receptors under CTE, but exceeded $1E-4$ for the future resident, full-time employee and older child trespasser under RME. Carcinogens of interest include tetrachloroethene in groundwater and PCBs, PAHs, and arsenic in soil. The risks associated with inhalation of indoor air were below the USEPA acceptable level of one for noncarcinogenic risks and below the USEPA acceptable target risk range of $1E-6$ to $1E-4$.

Human health risks were also evaluated to address potential health risks associated with child visitors, adult visitors, and full-time employee exposure under current site conditions. Incidental ingestion and dermal contact with soil were evaluated for the adult visitor, the child visitor, and the full-time employee, using data from surface soil sampling (0-12 inches beneath the ground surface) conducted in the vicinity of the museum exhibits and picnic area. The potential for exposure to soil is believed to be greatest in these areas. The inhalation of indoor air was also evaluated for occupational exposure to the full-time employee. All noncarcinogenic risks were below the USEPA acceptable level of one and all carcinogenic risks were below the USEPA acceptable target range of $1E-6$ to $1E-4$ for soil exposures. Air concentrations were compared to occupational standards and all concentrations were below those standards. The results of the evaluation concluded that minimal risks exist for the current child and adult visitor and the full-time employee.

E.9.3 Ecological Risk Assessment

Goss Cove is separated from the Thames River by a railroad embankment. The cove has been lined by rip-rap to stabilize the banks. No emergent vegetation grows in the cove and the majority of the land adjacent to the cove is either paved, comprised of rip-rap, or consists of maintained lawn.

While it is unlikely that ecological receptors such as waterfowl heavily utilize the cove as a feeding area, it is probable that the cove does support a benthic macroinvertebrate community. However, the fact that the cove has no direct connection to the Thames River limits the potential diversity of its aquatic community.

Due to the development of the former Goss Cove Landfill (i.e., the presence of the Nautilus Museum and the attendant parking lot), this area represents poor habitat for most wildlife receptors.

Several different sets of data have been collected from Goss Cove in support of the Phase II RI. Results of analyses conducted on samples of surface water and sediments collected from 5 locations in the cove indicated that several inorganics and organic compounds (i.e., metals and pesticides) were found at concentrations in excess of benchmark values protective of aquatic biota, suggesting that aquatic biota inhabiting the cove could be adversely impacted.

In response to the results of the studies conducted during Round I of the Phase II RI, an additional sediment sample was collected from Goss Cove during the Supplemental Ecological Sampling Round. The intent of the Supplemental Ecological Sampling Round was to focus more closely on the potential impacts that these contaminants might be having on aquatic biota and to determine if the contaminants were biologically available in concentrations that could represent an actual risk to the aquatic community.

The results indicated that four chemicals (aluminum, copper, nickel and heptachlor) were present in surface water at concentrations that represent a potential risk to aquatic biota. A number of chemicals also had HQs greater than 1.0, suggesting that benthic macroinvertebrates were potentially at risk. The results of toxicity tests confirmed that chemicals present in this sample were biologically available in concentrations that could adversely impact aquatic biota. Results of an SEM/AVS analyses to determine the biological availability of copper, cadmium, nickel, lead and zinc demonstrated that these five metals are not biologically available. Adverse impacts to test organisms (*A. abdita* and *L. plumosus*) exposed to sediments collected from station 8SD3 are more likely to be associated with the presence of other inorganics (mercury and cadmium) or organic compounds (e.g., gamma-chlordane, heptachlor, 4,4'-DDD, 4,4'-DDT, endrin aldehyde, dieldrin, and Aroclor-1254) that were present in concentrations that exceeded benchmark values for benthic receptors. The results indicated that sediments in Goss Cove could adversely impact aquatic biota.

E.9.4 Comparison to Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 13.8. Although not retained as soil COCs in the baseline human health risk assessment, methylene chloride, xylenes, bis(2-ethylhexyl)phthalate, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, heptachlor, selenium and silver were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. While these compounds may migrate to groundwater and potentially impact water quality, no dose-response parameters are available to quantitatively evaluate exposure to phenanthrene and

maximum detections of the remaining chemicals were less than risk-based COC screening levels for soil ingestion.

For groundwater, maxima of a few chemicals (chloroform, xylenes, acenaphthylene, phenanthrene, and sodium) exceeded the applicable state standards, but were not identified as COCs in the baseline human health risk assessment. No dose-response parameters are available to quantitatively address exposure to acenaphthylene, phenanthrene, and sodium. It should also be noted that the applicable state standard for sodium is a Notification Level for a drinking water source. Chloroform and xylenes were reported at maximum concentrations less than the risk-based COC screening levels for tap water ingestion.

Surface water and sediment data were also compared to state standards. With respect to human health AWQC for surface water, minimal exceedances of state criteria were observed. All chemicals with maximum detections in excess of the state AWQC for human health were selected as COCs in the baseline human health risk assessment. Although not retained as sediment COCs in the baseline human health risk assessment, benzo(k)fluoranthene, dieldrin and heptachlor were reported at maxima in excess of Connecticut soil remediation standards for pollutant mobility. While these compounds may migrate to groundwater and potentially impact water quality, maximum concentrations of these chemicals were less than risk-based COC screening levels for sediment ingestion.

For air data collected at the Nautilus Museum, several exceedances of state standards were observed. Those chemicals which were detected at elevated maximum concentrations, but were not selected as COCs, include 1,1-dichloroethene, styrene, and trichloroethene. Styrene was reported at a maximum less than the risk-based COC screening criteria for ambient air. Trichloroethene and 1,1-dichloroethene, which were detected in the samples obtained from the boiler room only, were not quantitatively evaluated in the human health risk assessment as museum personnel are not expected to spend their entire day in this area and visitors do not come in contact with this sampled location.

E.9.5 Recommendations

It is recommended that a Feasibility Study (FS) of remedial alternatives be conducted at the former Goss Cove Landfill. This recommendation is supported by the following information:

- Relatively high concentrations of chemicals are present in the site soils, and are impacting the groundwater and the adjacent Goss Cove. Numerous organic and inorganic constituents were found in soil at the site at notable concentrations. Similar inorganic and organic constituents were also detected in groundwater samples collected at the site, and it appears that an

upgradient source of PCE contamination to groundwater exists. Similar types of chemicals were detected in the soil, groundwater, and sediment indicating the occurrence of chemical transport.

- The human health risk assessment concluded that noncarcinogenic risks exceeded the USEPA acceptable level of one for the construction worker, the future resident, and the older child trespasser under the RME. Carcinogenic risks exceeded the upper bound ($1E-4$) of the USEPA acceptable target risk range of $1E-6$ to $1E-4$ for the RME full-time employee, RME older child trespasser, and the RME future resident. The noncarcinogenic risks and carcinogenic risks evaluated are partially attributable to exposure to tetrachloroethene in groundwater and arsenic in soil beneath the site. Arsenic is a commonly found natural constituent of soil. It should be noted that it is required (per OSHA standards for work on hazardous waste sites) that Health and Safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these measures would lower the risk to the construction worker to acceptable levels. It is also unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would therefore lower the risk to the future resident to acceptable levels.
- The Ecological Risk Assessment concluded that chemicals present in surface water and sediments represent a risk to the aquatic community in Goss Cove. Benthic macroinvertebrates represent the receptors primarily at risk in this system. While its small size and lack of a direct connection to the Thames River limits the potential productivity of Goss Cove, the presence of organic chemicals in the sediments, and the apparent potential for continued contaminant migration, represent long term potential risks to aquatic biota in the cove.

It should be noted that risks associated with the full-time employee scenario were calculated using USEPA recommended input parameters which are based on highly conservative estimates. Consequently, when unacceptable risks were calculated for this scenario, it was decided to re-evaluate risks for current realistic receptors. Human health risks associated with current site use were evaluated and included child visitor, adult visitor, and full-time employee exposure with soil, as well as full-time employee occupational exposure to indoor air. The results of the evaluation concluded that no unacceptable risks exist for the current child and adult visitor, as well as for the full-time employee.

It is recommended that a phased approach be used to proceed to a feasibility study (FS) for the former Goss Cove Landfill. Sufficient data has been collected during the Phase II RI to proceed with an FS with respect to surface water and sediment. With the exception of addressing the potential soil source and

extent of current PCE groundwater contamination at the Goss Cove Site, groundwater will be separated from other media and evaluated in a separate base-wide groundwater FS.

A Data Gap Investigation (DGI) has been performed for the Goss Cove Site with the primary objective to determine the source of PCE contamination detected during this Phase II RI in the groundwater beneath the former Goss Cove Landfill at well cluster 8MW8S/8MW8D. The findings of the DGI are included in "Data Gap Investigation Report for Goss Cove Landfill; BRE, March, 1997". Results of this DGI showed that PCE contamination originates off-base and is migrating into the Goss Cove Landfill Site from a southeasterly direction.

Although previous investigations have not completely defined the lateral extent of the landfill, it has been assumed that for FS purposes, the estimated limit of the landfill is relatively accurate given the natural site boundaries of the Thames River to the west, the bedrock hill to the north, Goss Cove to the south, and the lack of VOC contamination to the east. It is assumed that sufficient data regarding soil contamination exists to conduct the FS and that if additional data is required to determine the furthest extent of VOC contamination, it can be collected during the remedial design or remedial action.

E.10 LOWER SUBBASE

This section presents a summary of major findings of the Phase II RI at the Lower Subbase. A summary of the nature and extent of contamination is provided in Section E.10.1. Sections E.10.2 and E.10.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.10.4 summarizes the comparison of site data to state standards and Section E.10.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.10.1 Nature and Extent of Contamination

In spite of the fact that the Lower Subbase has been in use for more than 100 years, very little environmental contamination was identified in this area during the course of the Phase II RI. For evaluation purposes, four zones of the Lower Subbase have been identified and the discussion centers on these zones. Although various volatile organics were detected in soil samples, concentrations were typically quite low (i.e., from 1 to 20 $\mu\text{g}/\text{kg}$). Semivolatile organic analyses were not performed for soil samples during either the Phase I or Phase II RIs, however, it is expected that such compounds are present. This conclusion has been reached based on the detection of low levels of semivolatile organics in groundwater, and based on the presence of fuel-related compounds in soil. TPH analyses were completed as an indicator of fuel/oil contamination, and relatively high concentrations of TPH were encountered, particularly in the vicinity of

source Sites 10 and 11 in Zone 1, and Building 79 (Site 13) and the Quay Wall in Zone 4. The Phase I RI fluorescence spectroscopy data primarily indicated the presence of No. 2 fuel/diesel oil, No. 6 fuel oil, and lubricating oils. In addition, lead was detected at relatively high concentrations, particularly in surface soil in Zones 3 and 4. Analytical results for lead in the TCLP samples from Zone 2 and Zone 4 also exceeded Federal Toxicity Characteristic regulatory levels. Measures have been implemented to address lead (including solidification of lead contaminated soils at Building 31) to decrease the potential for contaminant migration.

Although several volatile and semivolatile organic compounds were detected in groundwater samples, most were detected infrequently and at relatively low concentrations (i.e., a few organic concentrations ranged up to 57 $\mu\text{g/L}$; most, however, were less than 10 $\mu\text{g/L}$). Manganese was detected at relatively high concentrations (up to 2,290 $\mu\text{g/L}$ in the sample collected during Round 2 of the Phase II RI from Zone 1 well 13MW8) in groundwater samples from all four zones.

Several metals, most notably lead at a concentration of 2,760 $\mu\text{g/L}$, were detected at elevated concentrations in the unfiltered groundwater sample collected from well NESO11 during Round 1 of the Phase II RI. As discussed in Section 14.4.2.4, these elevated concentrations were most likely due to the presence of suspended sediment in the sample.

Releases of petroleum products and oily substances have been observed in the Thames River in the vicinity of a storm sewer outfall near Pier 4 in November 1994. It appears that residual waste materials from past disposal practices at the Lower Subase entered the storm sewer and discharged into the Thames River. An expandable rubber plug has since been installed in the sewer line and no visible releases of petroleum product have been observed in the Thames River to date.

It appears that the Lower Subase may have impacted the Thames River due to the presence of elevated contamination in the sediment adjacent to the Lower Subase. Further discussion regarding the Thames River is included in Section 17.

E.10.2 Baseline Human Health Risk Assessment

The baseline human health risk assessment for the Lower Subase focused on three potential receptor groups: full-time employees, construction workers, and future residents. Noncarcinogenic risks were found to be below the USEPA acceptable limit of one for all receptor groups. Carcinogenic risks for all receptors at all zones were either less than $1\text{E-}6$ or within the USEPA's acceptable target risk range $1\text{E-}4$ to $1\text{E-}6$. The majority of the cumulative incremental cancer risks for the identified potential receptors were less than $1\text{E-}6$.

E.10.3 Ecological Risk Assessment

The Lower Subbase is located in a highly industrialized portion of the NSB-NLON and is characterized by large industrial buildings, a substantial amount of paved area, and very little maintained lawn. The area is characterized by heavy human activity and does not provide suitable habitat for wildlife. The only potential ecological habitat near the Lower Subbase is the Thames River (described in Section 17.3.6) which represents the Lower Subbase's western border. This portion of the Thames River is dominated by piers and serves as a docking and repair facility. Based on current conditions, ecological receptors are unlikely to come in contact with contaminants associated with the Lower Subbase and it is unlikely that the Lower Subbase represents a risk to ecological receptors.

E.10.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 14.8. TPH and lead, which were identified as COCs in the baseline human health risk assessment, were the only soil chemicals reported at maximum concentrations in the specific zones that exceeded the Connecticut remediation standards for pollutant mobility.

For groundwater in all zones, maximum detections of sodium in the unfiltered and filtered samples exceeded the state Notification Level for a drinking water source. This chemical was not retained as a COC in the baseline human health risk assessment, and no dose-response parameters are available to quantitatively evaluate exposure to sodium. For Zone 1 groundwater, acenaphthylene, phenanthrene, bis(2-ethylhexyl)phthalate, copper and mercury were not retained as COCs in the baseline human health risk assessment, but were reported at maxima in excess of Connecticut standards. A quantitative evaluation of exposure to acenaphthylene, phenanthrene, and copper was not provided in the human health risk assessment because of the lack of published dose-response parameters. Maxima of the remaining chemicals were less than the risk-based COC screening levels for ingestion of tap water.

Besides sodium, exceedances of Connecticut standards were also noted for a few chemicals detected in the groundwater at Zones 2 and 3. However, all of these chemicals were selected as COCs in the baseline human health risk assessment.

For Zone 4 groundwater, phenanthrene, mercury, and zinc were not retained as COCs in the baseline human health risk assessment, but were reported at maximum concentrations exceeding the state standards. As mentioned previously, no dose-response parameters are available to quantitatively evaluate exposure to

phenanthrene. Maximum detections of mercury and zinc were less than the risk-based COC screening levels for tap water ingestion.

E.10.5 Recommendations

It is recommended that further characterization of the Lower Subbase be performed during a separate RI. The characterization should focus on sampling and analyses to evaluate the nature and extent of lead, TPH, and semivolatile organic compounds in soil. Continued groundwater sampling and analyses is also required to monitor contamination levels. In addition, a focused data collection effort should provide information relevant to an FS to evaluate potential remedial options for the site. This recommendation is supported by the following information:

- Relatively high concentrations of lead in soil are present at Zones 3 and 4 in the vicinity of Site 17 (Building 31, Zone 3), Site 13 (Waste oil pit at Building 79, Zone 4), and the Quay Wall (Zone 4). Concentrations of lead were as high as 1,320 mg/kg in Zone 3 and 10,600 mg/kg in Zone 4.
- High concentrations of TPH in soil are also present at Zone 1 (Site 10 Fuel Oil Storage Tanks and Tank 54-H, Site 11 Power Plant Oil Tanks; maximum concentration = 51,600 mg/kg), Zone 3 (along Bull Head Road; maximum concentration = 3,400 mg/kg), and Zone 4 (waste oil pit at Building 79 and Quay Wall; maximum concentration = 11,800 mg/kg).
- Semivolatile organic compounds have not been analyzed in soil during the Phase I and II RI activities. Monitoring of these compounds are needed to evaluate risks associated with these contaminants. It is highly probable that semivolatile organic compounds will be detected at significant levels in soil, based on the presence of TPH. Semivolatile organic compounds are common components of TPH, and the concentrations of these compounds are not known.
- Petroleum products and oily substances have historically migrated into the Thames River in the vicinity of the Quay Wall. As discussed in the ecological risk assessment in Section 17.7, the Thames River sediment and shellfish community may be impacted in the vicinity of the Lower Subbase.

Pier 33 and Berth 16 are not addressed in this document. These sites have probable sources of contamination which could impact soil, groundwater, and the adjacent Thames River. The Navy is currently planning an expanded RI for the Lower Subbase to include the Pier 33 and Berth 16 area. The intent of the

expanded RI is to address concerns at the Pier 33 and Berth 16 area and to address data gaps for the Lower Subbase.

The expanded RI is being conducted in a tiered approach because of the considerable existing database. The Background Review Report for the Lower Subbase Remedial Investigation (B&R Environmental, March 1997) was developed as part of the first tier of data collection to accumulate data from several studies, including this Phase II RI, and to identify potential data gaps. Based on the results of the Background Report, a draft Work Plan for the Lower Subbase RI was developed and submitted to the regulatory agencies for review and comment in March 1997. Sufficient data will be collected in the Lower Subbase RI to proceed to a Feasibility Study where various remedial alternatives for this site will be developed and evaluated.

E.11 OVER BANK DISPOSAL AREA NORTHEAST

This section presents a summary of major findings of the investigations at the OBDANE site. A summary of the nature and extent of contamination is provided in Section E.11.1. Sections E.11.2 and E.11.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section E.11.4 summarizes the comparison of site data to state standards and Section E.11.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.11.1 Nature and Extent of Contamination

Minimal organic contamination was identified in the environmental matrices sampled at this site. For example, although volatile organics were detected in the soil samples, concentrations ranged no higher than 18 $\mu\text{g}/\text{kg}$ (toluene) and the concentrations of all remaining volatile organic analytes were less than 9 $\mu\text{g}/\text{kg}$. Although various PAHs were detected in the soil samples, concentrations of this class of chemicals ranged no higher than 110 $\mu\text{g}/\text{kg}$ (benzo[a]pyrene). Pesticides were also detected in the soil samples, but concentrations ranged no higher than 400 $\mu\text{g}/\text{kg}$ (4,4'-DDT).

However, more significant inorganic contamination was detected in surface soils to the south of the site. Arsenic was found at sample points 14MW1S-0002 and 14SS3 at concentrations of 10.4 mg/kg and 16.3 mg/kg, respectively. Also, lead was detected at sample point 14SS3 at a concentration of 403 mg/kg.

No organic chemicals other than carbon disulfide and bis(2-ethylhexyl)phthalate were detected in groundwater samples obtained at this site (1 $\mu\text{g}/\text{L}$ each). Although the one monitoring well installed at the OBDANE is not located immediately downgradient of the source area (well is located somewhat to the side and downgradient of the source area), the low levels of groundwater contamination present in this well are

probably representative of downgradient conditions because little contamination was noted in source area soils. Therefore, it is unlikely that groundwater is impacted from the site. Furthermore, based on the low concentrations of chemicals in the soil, it is highly unlikely that any impacts on downstream surface water bodies will occur.

E.11.2 Baseline Human Health Risk Assessment

Based on the relatively remote nature of the OBDANE site, construction workers and older child trespassers were considered the only potential receptors of concern for exposure to soil and groundwater. The noncarcinogenic risk estimates (HIs) for the evaluated exposure routes were all below the USEPA acceptable limit of one. Projected lifetime incremental cancer risks were either below or only slightly above the lower bound ($1E-6$) of the USEPA's acceptable target risk range ($1E-6$ to $1E-4$). Therefore, it is concluded that the site poses little risk to human health.

E.11.3 Ecological Risk Assessment

The OBDANE provides both cover and foraging area for wildlife receptors. Organisms inhabiting this area may come in contact with site soil while searching for food or burrowing in the soil (e.g., soil invertebrates). Using the conservative assumptions discussed in Section 3.4.4.2, the maximum concentrations of chemicals detected in surface soils (0 to 2 feet) collected from this site were compared to benchmark values protective of various terrestrial ecological receptors. The results of these comparisons indicate that chemicals detected at the OBDANE could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. When the risks associated with the average chemical concentrations in surface soil were evaluated, risks to these receptors were somewhat reduced but still exceeded 1.0. These results suggest that exposure to surface soil at the OBDANE presents a potential risk to terrestrial receptors. However, the OBDANE is relatively small and can only support a limited number of receptors. This fact, coupled with the conservative methods used in this assessment, suggest that actual risks to ecological receptors are likely to be less than those predicted in this assessment. It is concluded that the OBDANE represents little potential risk to ecological receptors.

E.11.4 Comparison of Site Data to State Standards

Arsenic in soil and sodium in groundwater were the only chemicals detected at maximum concentrations exceeding the state standards discussed in Section 15.8. Arsenic was selected as a COC in the baseline human health and/or ecological risk assessments. Sodium was not retained as a COC for direct exposure

to groundwater because of the lack of published dose-response parameters. It should be noted that the applicable state standard for sodium is a Notification Level for a drinking water source.

E.11.5 Recommendations

It is recommended that further characterization of the surface soil with respect to arsenic and lead contamination be conducted at the OBDANE for the following reasons:

- Although minimal contamination was detected in soil samples collected within, and adjacent to, the confines of the waste disposal area, more significant lead contamination was detected in surface soil sample 14SS3 located approximately 80 feet to the south of the site. This contamination could potentially migrate further offsite.
- Arsenic was found in site surface soils (samples 14SS3 and 14MW1S-0002) at concentrations slightly exceeding the state remediation standard for direct exposure under the industrial land use scenario.

Although contamination has been detected in surface soils at levels that exceed state standards and further investigation is required to finalize the nature and extent of contamination, relatively low human health and ecological risks are present at the site. This belief is based on the following supporting information:

- Human health noncarcinogenic risk estimates for the evaluated exposure routes were all below one. Projected lifetime incremental cancer risk estimates were all less than $1E-6$ or within the USEPA's acceptable target risk range of $1E-4$ to $1E-6$.
- The site is located in a remote area bounded by a chain link fence, thereby limiting access to human receptors.
- Although the Ecological Risk Assessment concluded that chemicals detected at the site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates, no apparent visible impacts to these receptor groups have been observed. In addition, the risk assessment was conservative, such that potential risks to these receptors are over predicted.
- The site is relatively small in size (80 feet in diameter) with minimal soil contamination. Therefore, the total volume of contaminated material is relatively low, and the available surficial

area for human and ecological exposure is somewhat limited. The site is also surrounded by large areas not known to be affected by waste disposal.

E.12 SPENT ACID STORAGE AND DISPOSAL AREA

This section presents a summary of major findings of the investigations for the Spent Acid Storage and Disposal Area. A summary of the nature and extent of contamination is provided in Section E.12.1. Section E.12.2 summarizes the baseline human health risk assessment for the site and E.12.3 summarizes the ecological risk assessment. Section E.12.4 summarizes the comparison of site data to state standards and Section E.12.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.12.1 Nature and Extent of Contamination

Minimal contamination was detected in environmental matrices sampled at the Spent Acid Storage and Disposal Area. Chemicals detected in the soil matrix included volatile organics at concentrations ranging no higher than 26 $\mu\text{g/kg}$ (xylenes), various semivolatiles including polynuclear aromatic hydrocarbons in up to four samples at concentrations ranging up to 3,705 $\mu\text{g/kg}$ (fluoranthene), pesticides ranging from 55 $\mu\text{g/kg}$ to 190 $\mu\text{g/kg}$ in one sample, and various metals. All lead concentrations in soil have been reduced to levels below 500 mg/kg as the result of the time-critical soil removal activity conducted at the site.

Several chemicals were also detected in site groundwater at low concentrations, including carbon disulfide (3 $\mu\text{g/L}$), bis(2-ethylhexyl)phthalate (5 $\mu\text{g/L}$ in the shallow well and 45 $\mu\text{g/L}$ in the deep well), naphthalene (1 $\mu\text{g/L}$), 1,4-dichlorobenzene (1 $\mu\text{g/L}$), di-n-butylphthalate (at concentrations less than 1 $\mu\text{g/L}$), phenanthrene (0.6 $\mu\text{g/L}$), and heptachlor (0.5 $\mu\text{g/L}$). With the exceptions of naphthalene, bis(2-ethylhexyl)phthalate, and phenanthrene, none of these chemicals were detected in the soil matrix at the site, so it is considered unlikely that the site is the source of this low level contamination. Furthermore, the presence of bis(2-ethylhexyl)phthalate at a higher concentration in the deep well is also considered indicative of an upgradient source.

Concentrations of PAHs detected in the sediment sample ranged from 25 $\mu\text{g/kg}$ to 250 $\mu\text{g/kg}$. Benzoic acid, carbazole, and phthalate esters ranging to 990 $\mu\text{g/kg}$ (dimethylphthalate) were also detected in the sediment sample.

E.12.2 Baseline Human Health Risk Assessment

Demolition of the buildings in the vicinity of this site is planned for the near future, followed by construction of a warehouse. Therefore, the risk assessment focused on construction workers and future potential residents as the primary receptor groups. The noncarcinogenic risk for the future resident under the RME exceeded the USEPA acceptable limit of one. Noncarcinogenic risks for the other exposure scenarios were less than one. Elevated risks for the RME future resident are attributed to manganese in groundwater via ingestion. This conclusion is similar to that found at many other sites through NSB-NLON (i.e., manganese is a commonly found naturally occurring metal and the primary contributor to site noncarcinogenic risks). The RME incremental lifetime cancer risks for the potential future resident exceeded the upper bound ($1E-4$) of the USEPA's acceptable target risk range of $1E-6$ to $1E-4$. Carcinogenic risks are attributed to bis(2-ethylhexyl)phthalate, 1,4-dichlorobenzene, heptachlor, arsenic, and beryllium.

E.12.3 Ecological Risk Assessment

As previously stated, this site does not provide a suitable wildlife habitat. Therefore, an ecological risk assessment was not performed for this site.

E.12.4 Comparison of Site Data to State Standards

Several chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 16.8. Of these chemicals, all were selected as COCs in the baseline human health risk assessment except for phenanthrene and zinc in groundwater. These chemicals were not retained as COCs since the maximum detection of zinc in groundwater was less than the risk-based COC screening criteria for tap water ingestion and no dose-response parameters are available to quantitatively assess exposure to phenanthrene.

E.12.5 Recommendations

No further action is recommended for this site based on the following information:

- Approximately 318 tons of lead contaminated soil has been excavated from the site. Soil samples collected after the excavation activity confirmed that residual concentrations were below 500 mg/kg total lead in soil or below 5 mg/L for lead in TCLP extract. Therefore, the source of contamination has been removed.

- Low levels of groundwater contamination remain at the site. No organic compounds detected at this site were in excess of 45 $\mu\text{g/L}$. The majority of the organic compounds detected in groundwater at the site were sporadically detected and were not detected in the soil at the site.
- Incremental lifetime cancer risks for construction workers under both scenarios and the future resident under the CTE were either below the lower bound ($1\text{E-}6$) or within the USEPA acceptable target risk range ($1\text{E-}6$ to $1\text{E-}4$). The incremental lifetime cancer risk for the RME future resident slightly exceeded $1\text{E-}4$. The noncarcinogenic risk for the future resident under the RME exceeded the USEPA acceptable limit of one, primarily the result of the detection of manganese in groundwater, which is a commonly found naturally occurring metal. It is unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would therefore lower the risk for the future resident to USEPA acceptable levels. It is also required (per OSHA standards for work on hazardous waste sites) that health and safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker.
- The Spent Acid Storage and Disposal Area and the nearby area are located in a paved parking lot in a well-developed portion of NSB-NLON. These features do not provide a suitable habitat for a wildlife population. Furthermore, it is unlikely that ecological receptors could come into contact with soils at this site because the area is covered with asphalt.

Although the baseline risk assessments indicated that this site does not pose an unacceptable risk, the CTDEP has indicated that site soils may adversely effect groundwater quality and therefore, under state Soil Remediation Standard Regulations, action must be taken even where the groundwater is not classified as a drinking water source. The state feels that there is insufficient data at this time to verify that the Spent Acid Storage and Disposal Area is not a continuing source of pollution to the groundwater.

It is anticipated that further characterization will be required to support "No Further Action" at this site. The characterization activities may involve additional soil analyses, SPLP tests, and/or modeling. If this testing program verifies that the soil at this site does not pose a threat to the groundwater, then the state will concur on a No Action Record of Decision.

E.13 THAMES RIVER

This section presents a summary of major findings of the investigation in the Thames River. A summary of the nature and extent of contamination is provided in Section E.13.1. Section E.13.2 and E.13.3 summarize the baseline human health risk assessment and the ecological risk assessment for the site, respectively. Section E.13.4 summarizes the comparison of site data to state standards and Section E.13.5 provides recommendations regarding additional action or investigatory efforts for the site.

E.13.1 Nature and Extent of Contamination

The nature and extent of contamination in surface water and sediment of the Thames River is not considered indicative of significant releases from NSB-NLON. Little variation in the nature of contamination was found in the sediment and surface water from upstream to downstream locations. Volatile organic chemicals were found to be relatively nonexistent in both matrices. By contrast, sorptive, hydrophobic chemicals such as pesticides and PAHs were found to be pervasive in the sediment matrix. Concentrations of PAHs increased slightly in the areas of Pier 33 and Berth 16, and increased substantially in the vicinity of the Lower Subase. Concentrations of PAHs in the samples collected near Goss Cove and in the downstream area, however, were similar to those detected in samples collected from the upstream area. No distinct pattern of metals contamination is evident based on the available surface water and sediment data.

Ribbed mussels were deployed in cages for 28 days. Although this period may have not have allowed tissue concentrations to have reached equilibrium, this exposure period was long enough for these organisms to accumulate biologically available contaminants for comparison to control samples. Analyses of the mussels indicated that chemical constituents were present. However, those same constituents were also detected at relatively the same concentrations in the control mussel samples (Figure 17-6). Mercury detected in a sample collected near Goss Cove and semivolatile compounds detected in the caged mussel samples adjacent to the Lower Subase represent two exceptions.

Chemical contaminants were also detected in native shellfish samples. However, the results were generally inconclusive in establishing a link with contamination detected at NSB-NLON. PAHs were detected in one blue mussel sample located adjacent to the Lower Subase. This may be indicative of impacts from NSB-NLON. It should be noted that a majority of the native shellfish samples were collected from the commercial shellfish beds which were located either across the Thames River on the other side of NSB-NLON, or were located somewhat upstream of NSB-NLON. No commercial shellfish beds are located in close proximity to NSB-NLON for sampling and monitoring purposes.

To convert wet weight to dry weight concentrations, wet weight contaminant concentrations were multiplied by 5 (NOAA, 1995). Dry weight concentrations of copper detected in native mussels collected near the NSB-NLON were found to range from 9 to 20 mg/kg. The NOAA Status and Trends Program reports an average value of approximately 10 mg/kg copper for the same species taken from contaminated sites. Analyses performed on mussels collected from the Raymark site on the Housatonic River determined that copper concentrations were less than 1 mg/kg, dry weight (Finkelstein, pers. com.). Data compiled by NOAA indicates that lethality in these species can occur at dry weight tissue concentrations ranging from 10 to 100 mg/kg copper, dry weight (NOAA, unpublished).

Dry weight copper concentrations measured in oysters collected from the Thames River near the NSB-NLON ranged from 311 to 1265 mg/kg. Data from the NOAA Status and Trends Program indicates that copper concentrations of 310 mg/kg are typically recorded in oysters collected from contaminated sites. Copper concentrations recorded at the Raymark site were 60 - 70 mg/kg (Finkelstein, pers. com.). Data compiled by NOAA indicate that lethality can occur in this species when tissue concentrations reach 5 - 900 mg/kg, dry weight (NOAA, unpublished). Zinc concentrations recorded in oysters collected from the Thames River ranged from 6050 to 14,800 mg/kg, dry weight. Zinc concentrations reported for oysters collected from the Raymark site equalled 1000 mg/kg while oysters collected from contaminated NOAA Status and Trends sites averaged 4000 mg/kg. Interpretation of the potential significance of the contaminant tissue concentrations measured in molluscs collected from the Thames River would have been enhanced if measurements to assess impacts to growth or body condition had been recorded as part of this study.

Heavy metals such as copper, zinc and iron are known to be essential to organisms whereas metals such as cadmium, lead, and mercury are regarded as non-essential. However, all heavy metals, whether essential or not, can be toxic when taken up in excess by aquatic invertebrates (Rainbow, 1996). The rates at which heavy metals are taken up by aquatic invertebrates depends greatly on external physiochemical factors (Sunda et al., 1978; Engel and Fowler, 1979; Luoma, 1983 as cited in Rainbow, 1996) and are generally beyond the short-term physiological control of these organisms (Nugegod and Rainbow 1988a; 1989a, 1989b; Simkiss and Taylor 1989a; Phillips and Rainbow, 1993 as cited in Rainbow, 1996). Aquatic invertebrate uptake of metals is generally by passive facilitated diffusion (Bryan, 1971, 1979; Simkiss and Taylor, 1989a as cited in Rainbow, 1996). Dissolved metals bind passively to membrane proteins and are then passed down a gradient of metal-binding ligands with increasing metal affinity (Rainbow, 1996). The metals eventually bind to large intracellular proteins, generally precluding their movement within and/or out of the organism. The "subsequent accumulation of a heavy metal by an invertebrate then depends on its particular accumulation strategy for that metal (Rainbow, et al., 1990; Phillips and Rainbow, 1993 as cited in Rainbow, 1996).

In general, heavy metals reach body concentrations in aquatic invertebrates that are orders of magnitude greater on a wet weight basis than external dissolved concentrations. If the metals remain in a biologically active form, then they have the potential to play a metabolic role (as in the case of an essential metal) or also to be toxic, since binding to intracellular molecules can interfere with their metabolic functioning. However, physiological processes exist that can detoxify body metallic concentrations in excess of metabolic requirements (if any) and, in some circumstances excrete them from the body (Rainbow, 1996).

Aquatic invertebrates exhibit extremes in bioaccumulation strategies. Some organisms accumulate all metal taken up with no significant excretion. In these instances, the metal must be stored in a detoxified form, except for that concentration of essential metal necessary of physiological processes. On the other extreme, an aquatic invertebrate may excrete all the metal that is entering in excess of metabolic needs, thereby a relatively constant body burden, presumably equivalent to physiological needs (Rainbow, 1996).

Interpretation of the significance of the concentration of a metal in an aquatic invertebrate depends heavily on a detailed study of the biology of the metal in that invertebrate (Rainbow, 1996). According to Rainbow (1996), it is impossible to establish background or baseline concentrations of metals in aquatic invertebrates. Even intraspecifically, the concentration of a metal may vary greatly as a result of inherent variability, not accountable by environmental or physiological factors. However, in the absence of differences in ambient metal bioavailability, individual variability with physiological state and other inherent individual variability remain to confound the interpretation of metal concentrations. It is difficult, then to define absolutely a body concentration range reflecting "normal" conditions because of such variability, but some intraspecific comparisons are possible, particularly when such comparisons include populations exposed to unusually high metal bioavailabilities. Such interpretations are the basis of any heavy metal biomonitoring program that would necessarily involve the use of net accumulators (Philips and Rainbow, 1993 as cited in Rainbow, 1996).

Typical biomonitoring data sets might be expected to fall conveniently into a group of "background" samples of approximately equal metal concentration, with remaining samples occupying a gradient of increased concentrations indicative of sites exposed to a range of increased metal bioavailabilities. In fact, physiological and other inherent individual variability often causes samples of the first group to fall along a gradient of concentrations themselves (Rainbow, 1993 as cited in Rainbow, 1996). In effect, it is impossible to define a point along the complete gradient of samples where increased metal bioavailability supersedes physiological or inherent variability as the primary determinant of a particular concentration. The presence of this gray area that is difficult to interpret does not, however, necessarily prevent conclusions to be drawn concerning samples at the top of any series of metal concentrations. It is often possible, therefore, to

conclude that the metal concentration of a particular sample indicates the presence of atypically high metal bioavailability, significantly raised above those of other sites monitored (Rainbow, 1996).

Toxic effects are not related to absolute body concentrations but are manifest only when the rate of uptake of a toxic metal exceeds the rates of physiological/biochemical detoxification and/or excretion. An invertebrate with a low total metal concentration may be suffering from sublethal toxic effects, resulting from a recent increase in metal uptake rate, while other conspecifics may be free from toxicity, although containing much higher metal concentrations accumulated in detoxified form over an extended time period (Rainbow, 1996).

The identification and quantification of different components of the total metal content of an invertebrate (e.g., metabolically available levels, temporary or permanent detoxified metal stores) offer scope for the interpretation of the significance of the metal concentration accumulated in that invertebrate (Rainbow, 1996). Furthermore, the comparison of intraspecific metal concentrations of aquatic invertebrates in a biomonitoring program does allow the identification of sites with raised toxic metal bioavailability.

Therefore, according to Rainbow (1996), the measurement of metal concentrations in aquatic invertebrates cannot tell us directly whether that metal is poisoning the organism. Nevertheless, in situations of metal contamination, the measurement of metal concentrations in a suite of well-researched biomonitors does allow use to recognize whether accumulations are atypically high, with a real possibility that toxic effects may be present, a vital step in any recognition of potential ecotoxicological effects in the environment.

E.13.2 Baseline Human Health Risk Assessment

Incidental ingestion and dermal contact with surface water by a recreational adult user (e.g., water skier) and ingestion of oysters, clams, finfish, and other shellfish (in spite of a ban on shellfish harvesting) were considered potential exposure routes for the Thames River risk assessment. Incidental ingestion and dermal contact with surface water by the adult recreational user were found to constitute negligible noncarcinogenic and carcinogenic risks were below the lower bound ($1E-6$) of the USEPA acceptable target risk range of $1E-6$ to $1E-4$. Carcinogenic risks associated with potential ingestion of oysters and clams each exceeded the USEPA acceptable target risk range of $1E-6$ to $1E-4$ under the RME scenario. In addition, noncarcinogenic risks for oysters, clams, and finfish/other shellfish ingestion exceeded the USEPA acceptable level of one under the RME scenario. Primary contributors to both the elevated risks for shellfish and finfish ingestions include heptachlor, arsenic, cadmium, and zinc.

E.13.3 Ecological Risk Assessment

The results of the various studies conducted on the Thames River indicate that areas that represent a potential risk to sensitive benthic invertebrates appear to be confined to sediment sample stations EC-SDTR04 (located midway between Pier 15 and Pier 17) and EC-T3SD4 (located adjacent to the DRMO) and only two chemicals (cadmium and endrin aldehyde) were present in surface water samples collected during the original Phase II RI sampling round in 1993 that exceeded their respective benchmark values. While consumption of prey may represent a potential hazard to waterfowl, actual risks to these receptors are likely to be much less than those predicted in this assessment due to the conservative assumptions used to calculate total potential doses received by these receptors.

Based on an evaluation of toxicity test results, benthic community studies, hazard quotients, and SEM/AVS, the ecological risk assessment concluded that risk to sensitive benthic invertebrates appear to be confined to stations EC-SDTR04 (midway between Piers 15 and 17) and EC-T3SD4 (adjacent to the DRMO). It is concluded that the Thames River near the site represents a minimal risk to ecological receptors.

E.13.4 Comparison of Site Data to State Standards

Surface water data from the Thames River was compared to state standards. For shallow and deep surface water trichloroethene and mercury were the only chemicals for which maximum concentrations exceeded the state AWQC for the consumption of organisms and/or water and organisms. Of these chemicals mercury was not selected as a COC in the baseline human health risk assessment. The maximum detection of this chemical was less than the risk-based COC screening criteria for tap water ingestion.

E.13.5 Recommendations

It is recommended that the Navy perform additional characterization of the Thames River in the vicinity of the Lower Subase. The further characterization should focus on sediment sampling and analyses for SVOCs and lead to define the nature and extent of sediment contamination along the Lower Subase. This information will be useful in relating contamination in the Thames River to source areas at the Lower Subase. Additional characterization of the potential impacts to the shellfish community in the vicinity of the Lower Subase may also be required. These characterization activities should be completed during the forthcoming Lower Subase RI. This recommendation is based on the following information:

- Concentrations of SVOCs particularly PAHs in sediment increase substantially in the vicinity of the Lower Subase when compared with upstream and downstream locations. Fluoranthrene and

pyrene were detected at maximum concentrations of 5300 $\mu\text{g/kg}$ for each compound when compared to upstream concentrations of 1000 $\mu\text{g/kg}$ for each compound, and downstream concentrations of 1100 $\mu\text{g/kg}$ for each compound.

- Semivolatile organic compounds were detected in caged ribbed mussel samples located adjacent to the Lower Subbase at concentrations above the caged mussel control sample concentrations. PAHs were also detected in a native blue mussel sample which was collected adjacent to the Lower Subbase.

It is also recommended that the future activities conducted at the DRMO and Goss Cove consider ongoing evaluation and monitoring of the Thames River as work progresses.

With the exception of potential impacts to the sediments and the shellfish community in the localized vicinity of the Lower Subbase, the observed nature and extent of contamination in the Thames River does not clearly indicate that NSB-NLON is the sole source of the problem. Noncarcinogenic risks are greater than the USEPA acceptable limit of one and carcinogenic risks are greater than the USEPA acceptable target risk range of $1\text{E-}6$ to $1\text{E-}4$ associated with RME shellfish ingestion. However, it should be noted that such risks are almost solely attributable to the presence of naturally-occurring chemicals in the tissues of these organisms. The cancer risk estimates for shellfish ingestion are substantially attributable to the presence of arsenic in the tissue (i.e., 98% of the risk). Noncarcinogenic risks are primarily attributable to the presence of arsenic and cadmium. Based on the fact that arsenic in shellfish tissues may be nontoxic and have no carcinogenic effects, the shellfish risk estimate may be substantially overestimated. Furthermore, a majority of the native shellfish samples were collected somewhat distant and upstream of NSB-NLON, and other sources may be contributing to some of the observed chemical detections.

Although contamination has been detected in sediment and shellfish adjacent to the Lower Subbase that requires further characterization, based on the information collected during the Phase I and II RIs, the following information is known:

- The surface water results showed that trichloroethene and butylbenzylphthalate were detected in one upstream sample at a concentration of 5 $\mu\text{g/L}$. Di-n-butylphthalate (0.6 $\mu\text{g/L}$) was detected in one sample in the vicinity of the DRMO and endrin aldehyde (0.14 $\mu\text{g/L}$) was detected in one sample adjacent to the Lower Subbase. No other organic compounds were detected in surface water samples. Therefore, as previously stated only sediment samples adjacent to the Lower Subbase requires further characterization.

- The ecological risk assessment concluded that the Thames River near NSB-NLON represents a minimal potential risk to ecological receptors. Only two chemicals in surface water (cadmium and endrin aldehyde) exceeded benchmark values, which indicates a potential risk to aquatic biota. Two of the sediment sample locations represented a potential risk to sensitive benthic macroinvertebrates. Furthermore, conservative assumptions were used in the calculations performed and actual risks to these receptors could be much less than predicted. Therefore, as previously stated benthic organisms adjacent to the Lower Subbase are the only ecological receptor that requires further characterization.

If the results of the focused characterization efforts at the Lower Subbase, Goss Cove, and DRMO reveal that the nature and extent of contamination is somewhat localized, and contaminant types and concentrations as similar to that found during the Phase I and II RIs, no additional work may be required in the Thames River. A reevaluation of the data collected during the focused characterizations and a comparison to the data collected during the Phase I and II RI will be required. At that time, a decision can be made regarding additional activities for the Thames River.

With regard to sediment risk investigations, it is recommended that all sediment sampling data available in the Pier 17 Replacement Study, the Seawolf Homeporting Environmental Impact Statement, and this Phase II RI be evaluated in the Lower Subbase RI, and subsequent reports associated with the Goss Cove and DRMO sites. This approach will allow for a more comprehensive evaluation of all available Thames River information in the vicinity of those potential source areas that could impact the Thames River.

Finally, it is recommended that the Thames River not be carried through as a site in the CERCLA process. It should be considered as part of other site-specific investigations, whereby each section of the Thames River adjacent to a particular site will be considered separately from other sections of the river.

E.14 OVERALL SUMMARY AND CONCLUSIONS

This section presents an overall summary and conclusions for each of the 13 sites investigated at NSB-NLON. Each of the individual sections for the site studies (i.e., Sections 5.0 through 17.0) included stand-alone summary and conclusion sections. Therefore, this section is intended to be a brief overall summary to support decision making and additional project planning.

Table 18-1 provides a brief synopsis of the recommendations for each of the sites studied. Table 18-1 identifies each of the various sites, includes the recommended action for each, and provides a succinct rationale for the recommendation(s).

As shown in Table 18-1, two of the sites investigated are recommended for no further action. These sites include the CBU Drum Storage Area and the Spent Acid Storage and Disposal Area. Limited further characterization will be required at the Spent Acid Storage and Disposal Area to support this recommendation. Although some contamination was identified at these sites, concentrations in all matrices were generally low and no evidence of significant contaminant migration was evident from the sites. In addition, human health and ecological risks were determined to be low. Risks that do exist are typically associated with naturally-occurring substances (particularly manganese).

Three sites are identified for potential remediation. The Area A Landfill is recommended for remediation based on the observed nature and extent of contamination, the results of the baseline risk assessment, and as a result of planned remedial efforts at the site. The Rubble Fill Area at Bunker A86 is also recommended for removal to accommodate installation of an upgradient interceptor trench as part of the Area A Landfill remediation. Removal of the OBDA debris is also recommended.

Additional characterization efforts have been recommended for the Area A Downstream Watercourses (volatile organic groundwater contamination), the Rubble Fill Area at Bunker A86 (assessment of downslope impacts and source investigation), the Torpedo Shops (abandoned sewer lines/leach fields investigation), the Lower Subbase (delineation of the complete extent of TPH, lead, and semivolatile organic contamination), the Over Bank Disposal Area - Northeast (delineation of lead and arsenic contamination), and the Thames River (sediments and potentially shellfish in the vicinity of the Lower Subbase as well as future evaluation in the vicinity of the DRMO and Goss Cove).

Finally, it is recommended that a Feasibility Study of remedial alternatives be completed for the former Goss Cove Landfill site, the Area A Downstream/OBDA, the Area A Wetland, Area A Weapons Center, and the Defense Reutilization and Marketing office. The former Goss Cove Feasibility Study recommendation is based on the presence of concentrations of organics and inorganics in the soil/fill and groundwater, evidence of offsite impacts (Goss Cove surface water and sediment, upgradient groundwater), and elevated potential human health and ecological risks. The Area A Downstream/OBDA Feasibility Study is recommended to address pesticide contamination in soils and sediment.

The Feasibility Study for the Defense Reutilization and Marketing Office is recommended to address residual contamination in soils and the potential to impact groundwater and the Thames River. Relatively low concentrations of contamination, limited mobility, and low human health and ecological risks are present at the Area A Wetland and Area A Weapons Center. A Feasibility Study will also be required at these sites to evaluate potential remedial alternatives. The Feasibility Studies recommended for the Area A Wetland, Area A Weapons Center, and Defense Reutilization and Marketing Office will focus on the evaluation of

monitoring and access/use restrictions ("Limited Action"), as well as "No Action", and more "Active Remediation" alternatives. A "Limited Action" alternative may be implemented if it compares favorable to other alternatives.

Consideration should also be given toward a base wide evaluation of the groundwater as a separate operable unit. This evaluation is needed to provide a more comprehensive regional perspective on the groundwater as it flows beneath, and discharges away from, NSB-NLON.

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TABLE ES-1

**SUMMARY OF RECOMMENDATIONS
PHASE I AND II RI SITES
NSB-NLON, GROTON, CONNECTICUT**

Site	Recommended Action	Rationale
CBU Drum Storage Area	No Further Action	Low concentrations and limited mobility. Low human health and ecological risks.
Area A Landfill	Containment/Management of Migration and Groundwater Monitoring	Demonstrated groundwater impacts. Potential human health impacts.
Area A Wetlands	No Further Action	Low concentrations and limited mobility. Low human health and ecological risks.
Area A Weapons Center	No Further Action	Low concentrations and limited mobility. Low human health and ecological risks.
Area A Downstream Watercourses/OBDA	Source Investigation (volatile organics) Delineation/Assessment of Downstream Contamination Revisit Feasibility Study to address pesticide contamination in soil and sediment.	Vinyl chloride detected in groundwater possibly from upgradient (torpedo shops) areas. High concentrations of metals and pesticides detected in sediments.
Rubble Fill Area at Bunker A86	Delineation of Downslope Contamination	High concentrations (phthalates, metals, and PAHs). Evidence of downslope migration.
Defense Reutilization and Marketing Office	No further action with monitoring of Wells Downgradient and Adjacent to Area of Volatile Organic Soil Contamination (6MW8S, 6MW3S/D).	High concentrations of volatile organics detected in soil - No significant groundwater impact evident to date. Remediation completed in January 1995 will mitigate potential exposure and associated risk.
Torpedo Shops	Investigation of soil and groundwater in the vicinity of abandoned sewer lines/leach fields.	Soil and groundwater contamination detected in the vicinity of abandoned sewer lines/leach fields. Nature and extent of contamination not known.

TABLE ES-1 (Continued)
SUMMARY OF RECOMMENDATIONS
PHASE I AND II RI SITES
NSB-NLON, GROTON, CONNECTICUT

Site	Recommended Action	Rationale
Former Goss Cove Landfill	Perform Feasibility Study of Alternatives	High concentrations of organics and inorganics in soil and groundwater. Evidence of offsite impacts exist. Elevated potential human health and ecological risk estimates.
Lower Subase	Conduct Additional Characterization Focusing on Lead, TPH, and Semivolatiles	High concentrations of lead and TPH detected in subsurface soils. Semivolatiles not quantitated but may contribute to human health risks. Thames River potentially impacted.
Over Bank Disposal Area, Northeast	No Further Action	Low concentrations and limited mobility. Low human health and ecological risks.
Spent Acid Storage and Disposal Area	No Further Action	Low concentrations and limited mobility. Low human health and ecological risks. Lead remediation completed.
Thames River	Conduct Additional Characterization Focusing on Sediment Contamination and potentially shellfish in the vicinity of the Lower Subase	Elevated semivolatile organic concentrations in sediment near the lower subase. Shellfish potentially impacted.

1.0 INTRODUCTION

This report presents the results of the Phase II Remedial Investigation (RI) and supplemental investigations conducted at the Naval Submarine Base-New London (NSB-NLON), located in Groton and Ledyard, Connecticut. It has been prepared for the Department of the Navy, Northern Division Naval Facilities Engineering Command, by Brown and Root Environmental (BRE), formerly Halliburton NUS Corporation (HNUS), under Contract Number N62472-90-D-1298 Contract Task Order 129, as part of the United States Navy Installation Restoration Program (IRP).

The Phase II RI was conducted as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (also known as Superfund) and Navy IRP RI programs to determine the nature and extent of contamination, to assess the human health and environmental risks posed by contamination, and to recommend remediation alternatives for 13 sites identified at NSB-NLON. The 13 Phase II RI sites include the following (Drawing 1, Volume III):

- Construction Battalion Unit (CBU) Drum Storage Area - Site 1
- Area A Landfill - Site 2
- Area A Wetland - Site 2
- Area A Weapons Center - Site 20
- Area A Downstream Watercourses and Over Bank Disposal Area (OBDA) - Site 3
- Rubble Fill Area at Bunker A-86 - Site 4
- Defense Reutilization and Marketing Office (DRMO) - Site 6
- Torpedo Shops - Site 7
- Goss Cove Landfill - Site 8
- Lower Subbase
- Over Bank Disposal Area Northeast (OBDANE) - Site 14
- Spent Acid Storage and Disposal Area (SASDA) - Site 15
- Thames River

The Phase II RI was completed in 1993 and 1994 by BRE, in accordance with the USEPA-approved Phase II RI Work Plan, prepared by Atlantic Environmental Services, Inc. (Atlantic, May 1993) as amended by the Phase II RI Addendum (HNUS, November 1993). A draft version of the Phase II RI Report was submitted for regulator review in February of 1995. The United States Environmental Protection Agency (USEPA) and the Connecticut Department of Environmental Protection (CTDEP) both reviewed and commented on the

report. Three subsequent scoping meetings were held between the Navy, USEPA and CTDEP to determine the appropriate course for the Navy to follow to address the regulator's comments and prepare a draft final version of the Phase II RI report. Based on the outcome of the meetings, it was determined that additional investigations were necessary to characterize the hydrogeologic conditions at the site and the risks to ecological and human health receptors. Supplemental Phase II RI investigations were performed in 1995 by BRE and were completed in accordance with the following documents: Final Work Plan for the Area A Landfill/Wetland Interface and Downstream/OBDA Sampling (HNUS, March 1995); Work Plan for Thames River Ecological Sampling (HNUS, March 1995); Letter Work Plan for Goss Cove Landfill (HNUS, July 1995); and Letter Work Plan for Area A Landfill Groundwater/Leachate Modeling Study (BRE, September 1995) and associated addenda (BRE, October 5, 1995 and BRE, October 25, 1995).

It was also concluded from the meetings, that changes were necessary to the methodology used to characterize risks to ecological and human health receptors. BRE prepared supplemental documents summarizing the new methodologies to be used and submitted them to the regulators on behalf of the Navy for review and comment. As a result of the regulators review, the methodologies were revised and finalized. These final methodologies were used to characterize risks to ecological and human health receptors in this report. It should be noted that new CTDEP regulations, which were adopted by the state in December of 1995 and which were not available during the scoping of the methodologies for the ecological and human health risk assessment, were used for this report.

1.1 PURPOSE OF REPORT

The purpose of this report is to present the results of the Phase II RI. It includes a summary of the Phase II RI field investigations, a description of individual sites, and a presentation of the results of the sampling, analyses, and evaluations for the 13 sites. The discussion of the results includes the nature and extent of contamination, an assessment of contaminant fate and transport, a baseline human health risk assessment, and an ecological risk assessment. In addition, this report compiles and presents data generated during previous site investigations and provides recommendations for further actions at each site.

Recommendations for each site include one or a combination of the following categories. Concurrence between the Navy, EPA, CTDEP, and all other interested parties is required regarding each recommendation.

- 1) Further characterization is required to collect data to sufficiently evaluate the nature and extent of contamination in order to determine if human and ecological receptors are exposed to unacceptable risks, or if regulatory criteria are being substantially exceeded.

- 2) A Feasibility Study (FS) is required to develop, screen, and evaluate remedial actions, based on unacceptable calculated risks to all human or ecological receptors or unacceptable exceedances of regulatory criteria.
- 3) No Further Action is required because the risks to human health or the environment that were calculated were acceptable or regulatory criteria have not been substantially exceeded. A decision document would be required to record the No Further Action decision.

1.2 BASE BACKGROUND

This section provides a brief description of base operations, a brief history of NSB-NLON, a summary of previous investigations, and a brief description of the 13 sites investigated for the Phase II RI. Detailed descriptions of individual sites are provided in the site-specific sections of this report.

1.2.1 Base Description

NSB-NLON is located in southeastern Connecticut in the Towns of Ledyard and Groton. Figure 1-1 illustrates the site locality. It encompasses approximately 576 acres on the east bank of the Thames River, approximately 6 miles north of Long Island Sound. The site is bounded to the east by Connecticut Route 12, to the south by Crystal Lake Road, and to the west by the Thames River. The northern border is a low ridge that trends approximately east-southeast from the Thames River to Baldwin Hill.

NSB-NLON currently provides base command for naval submarine activities in the Atlantic Ocean. It also provides housing for Navy personnel and their families and supports submarine training facilities, military offices, medical facilities, and facilities for the submarine maintenance, repair, and overhaul.

Land use adjacent to the base is residential and commercial, as illustrated on Drawing 1. Residential development along Military Highway, Sleepy Hollow, Long Cove Road and Pinelock Drive borders the site to the north and extends north into the Gales Ferry section of Ledyard. Property along Route 12 to the east of the base consists of widely-spaced private homes and open, wooded land. Development is mixed commercial and residential farther south on Route 12. It includes a church, automobile sales and repair facilities, convenience stores, restaurants, and a gas station. Private residences, an automobile service station, and a dry cleaners are located along the south side of Crystal Lake Road. Housing for Navy personnel exists farther south of Crystal Lake Road.

1.2.2 Base History

In 1867, the State of Connecticut donated a 112-acre parcel of land on the east bank of the Thames River to the Navy. The Navy did not use the property until 1868 when it officially designated the property a Navy Yard. The site was used to moor small craft and obsolete warships and served as a coaling station for the Atlantic fleet. The Department of the Navy designated the site a Submarine Base in 1916. During World War I, facilities at the base were extensively expanded; 6 piers and 81 buildings were added. In 1917, a submarine school was established, and in 1918 the Submarine Medical Center was founded.

NSB-NLON underwent another period of growth during World War II. Between 1935 and 1945 the Navy built in excess of 180 buildings and acquired land adjacent to NSB-NLON. The base expanded from 112 acres to 497 acres. The growth of NSB-NLON continued after World War II. In 1946 the Medical Research Laboratory was established.

In 1968 the Submarine School was changed from the status of an activity to a command and became the largest tenant on the base. The Naval Submarine Support Facility was established in 1974, and the Naval Undersea Medical Institute was established the following year. Presently, NSB-NLON consists of over 300 buildings on 576 acres of land.

On August 28, 1991 NSB-NLON was placed on the National Priorities List (NPL) by the United States Environmental Protection Agency (USEPA) pursuant to CERCLA and the Superfund Amendments and Reauthorization Act (SARA) of 1986. The NPL is a list of uncontrolled or abandoned hazardous waste sites identified by USEPA requiring priority remedial actions.

1.2.3 Previous and Ongoing Investigations and Related Documentation

Brief summaries of previous and ongoing investigations and activities associated with the 13 Phase II RI sites are provided in this section and are presented in Table 1-1.

Selected analytical data from previous investigations were evaluated and included in a database generated for the Phase II RI for determination of nature and extent of contamination and human health and ecological risk assessment. The previous investigations selected for inclusion in the database are indicated in Table 1-1. Further discussion of the database and the selection rationale for the database is provided in Section 3.0.

1.2.3.1 Lower Subase Study (1979)

In 1979 the Navy Environmental Support Office (NESO) conducted a study to identify the source and extent of oil found in soils along the Thames River at three sites on the Lower Subase. The three sites were Building 29 Power Plant Oil Tanks (Site 11), Building 107/345 Fuel (Oil) Storage Tanks (Site 10), and Building 79 Waste Oil Pit (Site 13). NESO drilled a total of 16 soil borings and installed piezometers in each soil boring. Soil samples from each boring were analyzed for oil content. Groundwater samples were collected from each piezometer to check for the presence of oil and, where present, to measure product thickness.

The study found oil extending toward the Thames River near the Building 29 Power Plant Oil Tanks. No significant contamination was detected at Building 107/345, and oil identified as lubricating oil was found in the vicinity of Building 79. The NESO report recommended: 1) an inspection of the tanks and storm sewers on the Lower Subase; 2) the abandonment of the Building 79 waste oil pit and the installation of a recovery well system; and, 3) monitoring around Building 107/345.

The Building 79 waste oil pit was eventually filled with concrete, and a recovery well system was installed sometime around 1985. It operated for a period of several months but was determined to be ineffective and later abandoned.

1.2.3.2 Final Initial Assessment Study (1983)

In 1982 Envirodyne Engineers, Inc., performed an Initial Assessment Study (IAS) at NSB-NLON as part of the Navy Assessments and Control of Installation Pollutants (NACIP) program. The purpose of this study was to identify and evaluate past waste disposal practices and to assess the potential for environmental impacts. Envirodyne reviewed installation records, interviewed long-term and former employees, toured the installation, and photographed sites as part of the IAS.

Envirodyne identified 11 sites as having contained hazardous material. Of the 11 sites identified, five sites were suspected to be contributing contaminants to the environment. The report recommended no further actions be pursued at CBU, Goss Cove Landfill, Building 79, and SASDA. It recommended various actions for Bunker A-86, the Building 107/345 Fuel Oil Storage Tanks, Building 29 Power Plant Oil Tanks, and OBDANE. It also recommended a Confirmation Study be conducted for Area A Landfill, OBDA, and DRMO.

1.2.3.3 Lower Subase Site Investigation (1987)

In 1987 Wehran Engineering Corporation completed an investigation to identify and delineate the sources of heavy oils in the subsurface of the Lower Subase (Sites 10, 11, and 13). Soil samples from soil borings, sludge samples from manholes, and groundwater samples from monitoring wells were tested to identify the type, degree of weathering, and general concentrations of oil contamination at the three sites.

Wehran identified three areas contaminated with heavy oil: (1) a concrete utility trench and oil line near Argonaut Road contained No. 6 fuel oil younger than 1 year old (Site 11) ; (2) manholes and the area underneath the supporting platform in the vicinity of Building 79 (Site 13) contained No. 6 fuel oil older than 1 year and trace levels of waste oil; and, (3) electrical conduits and manholes along Corvina Road contained a mixture of No. 5 and No. 6 fuel oils.

Wehran recommended three actions: (1) inspection of the No. 6 fuel line and cleaning of the contaminated utility trench; (2) removal of the sludge oil from the manholes near Building 79 by using absorption pads and/or excavation of oil-laden soils; and, (3) further study of the electrical conduits and manholes and review of the oil supply and distribution system of Building 29.

The first recommendation was implemented by inspecting and replacing the No. 6 fuel oil and diesel lines running along Argonaut Road from the valve house at the gate of the Lower Subase to the Power Plant. Fuel lines along Corvina Road running to the piers were also recently replaced.

1.2.3.4 Area A, OBDA, and DRMO Verification Study (1988)

Wehran Engineering Corporation conducted a Verification Study from December 1984 to April 1985 for the Area A Landfill and Wetlands, OBDA, and DRMO, known then as (DPDO). The purpose of the study was to verify the presence or absence of contamination at the sites indicated and to recommend whether additional study was warranted.

Three rounds of surface water and sediment sampling were collected at six locations in the Area A Landfill and Wetlands. One of the six locations was in the wetland area of the Over Bank Disposal Area. The first round of samples was analyzed for volatile and semivolatile organics, pesticides, polychlorinated biphenyls (PCBs), and inorganics. The samples from the second and third rounds were analyzed for volatile organics and inorganics. In addition, three soil borings were installed at DRMO. Soil samples were collected and composited from each soil boring. The soil samples were analyzed for volatile and semivolatile organics, pesticides, PCBs, and inorganics.

Wehran concluded that the soil at DRMO and the surface water and sediment in Area A had been impacted and contained contaminants in concentrations that posed risks to public health and the environment. It recommended that a Site Characterization Step 1B, hydrogeological investigation, be performed at both sites.

1.2.3.5 North Lake Analytical Data (1988-1993)

Each summer North Lake is filled with municipal water and chlorinated for recreational use by Naval officers and their families. Since 1988, the Navy has collected and analyzed surface water and beach sand samples from North Lake to ensure that the lake is safe. Sampling has been conducted at the lake because of its location within the Area A Downstream Watercourses. Representative analytical results from this sampling have been evaluated for the Phase II RI for the Area A Downstream Water Courses and are discussed in Section 9.0.

1.2.3.6 Data Report of Additional Borings, DRMO Conforming Storage Facility Report (1989)

In April and June of 1989 Goldberg-Zoino & Associates, Inc., (GZA) drilled six test borings at DRMO in preparation for the erection of a Conforming Storage Facility (hazardous waste storage) in the northern portion of the site. GZA collected a total of ten soil samples for analysis. Three composite samples were analyzed for priority pollutant metals, Toxicity Characteristics Leaching Procedure (TCLP) metals, and EP toxicity metals. The remaining 7 grab and composite samples were analyzed for TCLP volatile organic compounds.

Metals were detected at varying concentrations in all samples for the various metal analytical methods. Three volatile organic compounds were detected for TCLP. The report only presented the analytical results and did not provide any recommendations.

1.2.3.7 Hydrogeologic Investigation UST OT-4, OT-7, OT-8, OT-9, and Tank 54-H (1989)

In 1989 Fuss & O'Neill, Inc., conducted a hydrogeologic investigation of two underground storage tank (UST) areas at NSB-NLON: OT-4, OT-7, OT-8, and OT-9 of the tank farm area and tank 54-H of the Lower Subbase. The study was initiated as a result of subsurface soil contamination encountered during construction activities in the two areas. Four soil borings were installed around OT-4, and four monitoring wells were installed around each of the remaining tanks. Soil samples were collected from each boring and well and field screened with an organic vapor monitor (OVA). One soil sample from each boring around tank OT-4 was analyzed by a laboratory for volatile aromatics and screened for petroleum products.

Groundwater samples from each of the monitoring wells were analyzed by a laboratory for volatile aromatics and petroleum products.

No. 2 fuel oil was detected in monitoring wells at tanks OT-7, OT-8 and tank 54-H. Fuss & O'Neill concluded petroleum contamination had impacted groundwater of the two tank areas.

1.2.3.8 Offsite Residential Well Investigation (1990-1993)

From December 1990 to December 1993, Atlantic conducted seven rounds of groundwater sampling and analysis of 25 off-site residential wells to assess potential impacts from waste management and disposal practices at NSB-NLON. The preliminary conclusion from the investigation was that the off-site residential wells were not being impacted by NSB-NLON.

1.2.3.9 Multi-Media Inspection (1991)

In April and June 1991 USEPA and CT DEP conducted a multi-media environmental inspection of NSB-NLON. The multi-media inspection was to ensure NSB-NLON was in compliance with the Clean Air Act, RCRA, Toxic Substances Control Act (TSCA), and the Clean Water Act. Visual inspections, documentation review, and sampling were conducted by inspection teams at numerous locations across the site.

Deficiencies in compliance with all four acts were reported. NSB-NLON contacts indicated recommendations would be acted upon.

1.2.3.10 Phase I Remedial Investigation (1992)

An investigation of 11 sites was completed at NSB-NLON by Atlantic Environmental Services, Inc., from 1990 through 1992. Atlantic investigated seven of the eleven sites as Initial Site Inspections (ISIs) and four sites under a Phase I Remedial Investigation. The eleven sites investigated by Atlantic include the following:

ISI

- Construction Battalion Unit Drum Storage Area - Site 1
- Bunker A-86 - Site 4
- Torpedo Shops - Site 7
- Goss Cove Landfill - Site 8
- Over Bank Disposal Area Northeast - Site 14

- Spent Acid Storage and Disposal Area - Site 15
- Former Gasoline Station - Site 18

RI

- Area A - Site 2
- OBDA - Site 3
- DRMO - Site 6
- Lower Subbase - Site 13

As a result of the investigation of these sites, Atlantic recommended that additional investigations be conducted at each of the sites with the exception of the Former Gasoline Station. Furthermore, Atlantic indicated that four specific areas within Area A (Landfill, Wetlands, OBDA/Downstream, and the Weapons center) and the Thames River should also be investigated.

The Atlantic investigations are summarized in the Phase I RI report (Atlantic, August 1992). Site-specific discussions of the results of the Atlantic investigations are included in subsequent sections of this report.

1.2.3.11 Draft Focused Feasibility Study (FFS) for DRMO (March 1994)

In March 1994 Atlantic prepared a Focused Feasibility Study (FFS) for the DRMO (Site 6) to evaluate and select remedial actions for mitigation of risks to human health and the environment associated with contaminated soils at the site. The study identified and screened remedial technologies/process options, developed and screened remedial alternatives, analyzed remedial alternatives, and compared remedial alternatives. Data from the Phase I RI (Atlantic, 1992) were used in support of this FFS. Additional data was collected for the FFS from 17 borings that were drilled and the analysis of 23 soil samples.

Atlantic selected four remedial alternatives as viable remedial options: no action, installation of a cap over areas of the site that contain contaminated soils above target remediation levels, removal and disposal of contaminated soil at an off-site RCRA landfill followed by the placement of an impervious cover over the area, and on-site thermal desorption of contaminated soil and the placement of an impervious cover over the area. From the comparative analysis of the remedial alternatives, Atlantic recommended the on-site thermal desorption and disposal at an off-site landfill as the superior remedial alternatives.

Off-site landfilling of contaminated soil and installation of a cap were implemented by the Navy as Interim Remedial Actions in the fall of 1995, as reported in the Final Report for Interim Remedial Action, Site 6 (Section 1.2.3.23).

1.2.3.12 Draft Focused Feasibility Study for Spent Acid Storage and Disposal Area (March 1994)

Atlantic prepared a Focused Feasibility Study for the Spent Acid and Disposal Area (Site 15) in March 1994 to select remedial actions for mitigation of risks to human health and the environment associated with contaminated soils at the site. The feasibility study process included the identification and screening of technologies, the development and screening of remedial alternatives, the detailed analysis of remedial alternatives, and the comparative analysis of remedial alternatives. Analytical data from the Phase I RI (Atlantic, 1992) were used in support of this FFS. A supplemental site investigation was conducted for the FFS. It included the drilling of six test borings and the collection and analysis of six soil samples from the test borings.

Atlantic selected four remedial alternatives as viable remedial options: no action, installation of a cap, off-site landfill of contaminated material, and on-site soil washing. From the comparative analysis of the remedial alternatives, Atlantic recommended on-site soil washing and off-site landfill as superior remedial alternatives for overall protection of human health and the environment.

The Navy implemented the off-site landfill alternative in the beginning of 1995, as documented in the OHM Final Report for Soil Remediation of Spent Acid Storage and Disposal Area (OHM, 1995) (Section 1.2.3.25).

1.2.3.13 Draft Focused Feasibility Study (FFS) for Area A Downstream/OBDA (April 1994)

In April 1994 Atlantic prepared a FFS for the Area A Downstream/OBDA (Site 3) to select remedial actions for mitigation of risks to human health and the environment associated with contaminated sediments and soils at the site. The study included the performance of supplemental site investigations, a risk assessment based on the investigation results, the identification and screening of remedial technologies, the development and screening of remedial alternatives, detailed analysis of remedial alternatives, and the comparative analysis of remedial alternatives. Chemical and ecological data from the Phase I RI (Atlantic, 1992) were used in support of this FFS. In addition, 18 surface soil and 60 sediment samples were analyzed for the FFS. A freshwater aquatic and terrestrial supplemental ecological field investigation was also conducted during this FFS.

Atlantic selected four remedial alternatives as viable remedial options: no action, installation of a 1-acre cover over the area, off-site landfilling of sediment dredged from the area, and on-site thermal desorption of sediment dredged from the area. From the comparative analysis of the remedial alternatives, Atlantic recommended the on-site thermal desorption and disposal at an off-site RCRA landfill as the superior remedial alternatives.

1.2.3.14 Environmental Assessment for Pier 17 Replacement (September 1994)

In September 1994, Maguire Group, Inc. prepared an Environmental Assessment for the proposed dredging alongside Pier 15 and 17. Three alternatives for the dredging were evaluated: no action, modification to the existing dry docks at the piers, and Pier 17 replacement. Pier 17 replacement was ranked the highest of the alternatives but the most costly. In addition, dredged material disposal alternatives were evaluated. Three alternatives were evaluated: landfilling, confined disposal facility, and open water disposal. The open water disposal alternative was considered the most desirable with minimal environmental impacts. It was proposed that the contaminated sediment be capped with clean sediment to mitigate long-term environmental effects. Twenty-four sediment samples were collected along the Thames River in 1990 and 1991. The sediment samples were analyzed for percent water, total volatile solids, total organic carbon, total petroleum hydrocarbons, oil and grease, percent silt/clay, metals, and polycyclic aromatic hydrocarbons (PAHs).

From the sediment sampling and analysis, the report concluded that the upper sediment (0-3 feet) contained higher concentrations of metals and PAHs than the lower sediment layers. Pesticides and PCBs were also detected at low levels in the upper sediment layers. Because of the results, two composite samples from Pier 17 and Pier 15 were collected for 10-day benthic toxicity tests on *Ampelisca abdita*. The results of the toxicity tests showed that amphipod mortality using site-specific sediment was not statistically greater than the mortality using reference sediment and the mortality for the site-specific test did not exceed the mortality for the reference test by more than 20 percent. Three sediment grab samples were also collected in the vicinity of Pier 17 and Pier 15 to provide a general description of the benthic communities associated with the sediments of Piers 15 and 17 and to provide an assessment of the potential impacts of the fauna in the project area. Three surface water and sediment samples were also collected for an elutriate test as part of this assessment.

The report concluded the proposed action will have short-term effects on Thames River water quality, no effect on recreational or commercial navigation, and minimal effects on fish and benthic species.

1.2.3.15 Post Removal Action Report for Building 31 Lead Remediation (January 1995)

In response to the discovery of lead contamination in the soil beneath the concrete floor slab of Building 31 (Site 17) on the Lower Subbase during construction activities in 1992, the Navy initiated a time-critical removal action. The removal action consisted of excavation of lead contaminated soil above mean low tide elevation; on-site solidification, and stabilization; backfilling of stabilized soil within Building 31; installation of a concrete

floor over the stabilized, backfilled soil; and, backfilling with clean fill in the excavated areas outside of Building 31 by National Environmental Services Corporation. Also, demolition debris and excavated materials not suitable for solidification/stabilization were screened for contamination and off-site landfilled either as hazardous or non-hazardous material.

Based on the results of the post-removal action field verification sampling and analysis, BRE indicated that the excavation areas beneath Building 31 and along Bullhead Road were no longer contaminated, and no further action was required. However, the Navy postponed further removal action beneath Albacore Road as not to interfere with base operations. Alternatively, a non-woven geotextile liner was installed in the excavation along Albacore Road and backfilled with clean fill. The liner will prevent further contaminant migration and allow for easy resumption of future removal actions.

1.2.3.16 USEPA Federal Facilities Agreement (FFA) (January 1995)

In January 1995 the Navy, USEPA, and the State of Connecticut signed the USEPA FFA for NSB-NLON. The general objectives of this agreement are to:

- Ensure that environmental impacts associated with past and present activities at NSB-NLON are thoroughly investigated and that the appropriate remedial action is pursued as to protect health and the environment;
- Establish a procedural framework and timetable for developing, implementing, and monitoring appropriate responses at NSB-NLON, in accordance with CERCLA (and SARA amendment of 1986), the National Contingency Plan (NCP), Resource Conservation and Recovery Act (RCRA) and Hazardous and Solid Waste Amendment (HSWA) of 1984), Executive Order 12580, and applicable state law; and,
- Facilitate cooperation, exchange of information, and participation of the above stated parties in such actions.

1.2.3.17 Pier 33 and Berth 16/Former Incinerator Site Inspection (February 1995)

Following discovery of petroleum hydrocarbon contamination in the soils at Pier 33 and Berth 16/Former Incinerator in 1989, these sites were added to the IR Program. Atlantic conducted site inspections at the two sites to determine the presence or absence, as well as, the magnitude of specific contaminants, and to determine if the results warrant an RI/FS. Atlantic conducted soil gas surveys at both sites and drilled

a total of 22 soil borings. Atlantic collected 42 soil samples from the 22 soil borings. Atlantic installed and sampled 9 monitoring wells. In addition, Atlantic collected 1 surface soil sample from Pier 33 and two sediment samples from each site. Samples were analyzed for most or all of the following: volatile and semivolatile organics, pesticides, PCBs, inorganics, TPH, and oil identification by fluorescence.

The soil gas survey results varied greatly, with some elevated detections at Pier 33. In addition, varying levels of volatiles and semivolatile organics and TPH were detected in subsurface soils from Pier 33. No. 2 fuel oil were identified by fluorescence. PCB levels were below To Be Considered (TBC) values, but nine metals were detected above background levels. Only lead was detected for TCLP above the TBC value. Toluene was the only volatile detected in the sediments from Pier 33. TPH and semivolatiles were detected at varying levels in the sediment, and 10 metals were also detected. No. 4 fuel oil and No. 6 fuel oil were identified in the sediments. Low levels of volatiles and semivolatiles were detected in the groundwater from Pier 33, but no TPH, pesticides or PCBs were detected. Residual fuel oil, No. 4 fuel oil, and No. 6 fuel oil were identified in the groundwater.

Soil gas survey results also varied for Berth 16. Volatiles were detected at low levels in the subsurface soils from Berth 16. TPH and semivolatiles concentrations correlated well for the subsurface soil samples. Residual fuel oil and No. 2 diesel fuel oil were identified by fluorescence. No PCBs were detected but pesticides were detected at low levels and dioxin was detected at one location. Elevated levels of inorganics were detected in soil samples from all the soil borings from Berth 16. Volatiles were detected at low concentrations in the two sediment samples from Berth 16. Semivolatiles and TPH were detected at moderate to elevated levels, but no pesticides or PCBs were detected. No. 6 fuel oil was identified as the oil present. Several inorganics were detected above background levels. Volatiles and semivolatiles were detected in low concentrations in the groundwater samples from Berth 16. No TPH, pesticides, or PCBs were detected. No. 4 or No. 6 fuel oil was identified as the oil present in the groundwater.

The report recommended remedial investigations be conducted at the two sites.

1.2.3.18 Supplemental Site Investigation for Area A Landfill (March 1995)

Atlantic conducted a supplemental site investigation of the Area A Landfill to fill data gaps of the Phase I RI (Atlantic, 1992) and to prepare a FFS and remedial design for the site. The investigation results are included in this Phase II RI report as well as the Area A Landfill FFS. Twenty-four borings were installed at the bituminous concrete pad at the site. Thirteen subsurface soil samples and four bituminous concrete samples from the borings were sent for laboratory analysis.

The report concluded that the levels of dioxin and inorganics detected did not appear to pose a threat. TCL VOCs, SVOCs, and pesticides were detected at elevated levels across the site. PCBs were detected at levels below To Be Concerned Values (TBCs).

1.2.3.19 Background Soils Investigation (April 1995)

Atlantic completed background soil sampling at NSB-NLON in April 1993. The background investigation was conducted to characterize the concentrations of naturally-occurring inorganics and anthropogenic compounds (organics) to support site data evaluation and risk assessment. The background information and statistical analysis procedures are discussed in the report, and the final results are listed in Table 1-2. No volatile or semivolatile compounds were detected in the background samples. The results of the background study have been used in this Phase II RI and are discussed in Section 3.3.1.

1.2.3.20 OT10, Building 325, and Building B-89 UST Site Characterization (April 1995)

HNUS conducted site investigations at OT-10, Building 325, and Building 89 in June and November 1994 to determine if the USTs at these sites had impacted the surrounding soil and groundwater.

In June 1994 M&G Associates removed tank Z01 located at Building 89. Three soil samples and one groundwater sample were collected from the tank grave. Eight monitoring wells were installed at Oil Tank 10 (OT-10) in November 1994. Eighteen soil samples were collected during the well installations. Eight groundwater samples were then collected from the installed monitoring wells. One wastewater sample and one waste oil sample were collected from OT-10 for content determination. Seven soil borings were drilled at Building 325 in November 1994. Eleven soil samples were collected from the soil borings. Of the seven soil borings, four borings were converted to monitoring wells. Four groundwater samples were collected from these wells.

At OT-10, toluene, ethylbenzene, xylenes, pyrene, 4,4'-DDE, lead, and other inorganics were detected in soil samples. Xylene, di-n-butylphthalate, lead, and other inorganics were detected in groundwater samples from OT-10. Xylenes, petroleum hydrocarbons, and inorganics were detected in soil samples from B-325. Only xylene was detected in the groundwater of B-325. Benzene, toluene, ethylbenzene, xylenes, semivolatiles, and TPH were detected in the soils at B-89.

All detections from the OT-10 and B-325 sites were below Connecticut Department of Environmental Protection (CTDEP) industrial cleanup standards, but some exceeded residential cleanup standards. No further action was recommended for OT-10 and groundwater monitoring was suggested for B-325.

Subsequently, the Navy decided to remediate the petroleum contamination at B-325 instead of groundwater monitoring. Remediation has been completed at this time and a final version of the report is forth coming which summarizes the remedial actions. At B-89 the detections in the soil samples were below CTDEP cleanup standards. The report concluded that the groundwater at B-89 had been impacted by petroleum related to the tank, but it recommended no further action because the area was being investigated under the Phase II RI.

1.2.3.21 Preliminary Assessment/Supplement to Initial Assessment Study (1995)

Naval Facilities Engineering Service Center (NFESC) prepared a supplement to the Initial Assessment Study (SIAS) to identify assess possible environmental contamination that may have occurred since the initial assessment study, conducted in March 1983. Of the 13 sites studied for the SIAS, only the DRMO, Area A Downstream and Torpedo Shops were Phase II RI sites. NFESC reviewed relevant documents and interviewed site personnel for the SIAS.

1.2.3.22 Geotechnical Field investigation for Area A Landfill (May 1995)

In February 1995 HNUS conducted field investigations at the Area A Landfill in support of the remedial design for a landfill cover system. Eight test borings were drilled to determine the depth of bedrock and the extent of landfill material. Three soil samples from the test borings were collected for chemical analysis. Six soil samples were also collected from the test borings for engineering parameters. Twenty test pits were excavated to determine the type and extent of landfill material and, along the southern boundary, the depth and competence of bedrock.

The results of the geotechnical field investigation were used in the remedial design of a cap for the Area A Landfill. The chemical analytical results from this investigation indicated that the subsurface soils east of the Area A Landfill were essentially non-contaminated.

1.2.3.23 Quay Wall Removal Site Evaluation (May 1995)

HNUS prepared the Quay Wall Removal Site Evaluation to summarize removal actions performed in November and December 1994 to remedy petroleum product releases that occurred along the Quay Wall of the Lower Subase. Five monitoring/product wells were installed in five of six soil borings drilled along Albacore Road. Five subsurface soil samples and one oil/sludge sample were collected. Lead was identified as the only chemical of concern, and the Removal Site Evaluation recommended that no further removal actions be performed at that time but that further site investigations were needed.

1.2.3.24 Area A Landfill/Wetland Interface Sampling (May 1995)

HNUS conducted sampling activities along the Area A Landfill/Wetlands interface in November 1994 to supplement the FFS for the Area A Landfill. Sediment/soil samples were collected from 20 locations along 10 transects across the Area A Wetlands/Landfill interface.

Volatile and semivolatile compounds, pesticides, and low-level concentrations of inorganics were detected in various samples. One PCB compound was detected.

1.2.3.25 Focused Feasibility Study for Area A Landfill (May 1995)

In May 1995 Atlantic prepared a FFS for the Area A Landfill to evaluate and select remedial actions for mitigation of risks to human health and environment associated with contaminated soils at the site. The study included the identification and screening of remedial technologies, the development and screening of remedial alternatives, remedial alternative analysis, and the comparative analysis of remedial alternatives. Data from the Phase I RI (Atlantic, 1992), the Supplemental Site Investigation for Area A Landfill (Atlantic, 1995), and the Area A Landfill/Wetlands interface sampling by HNUS (1995) were used in support of this FFS. In addition, twenty-three geotechnical borings were drilled by Atlantic for the FFS.

Atlantic selected four remedial alternatives as viable remedial options: no action, installation of a cap, off-site RCRA landfill of contaminated material, and off-site incineration of contaminated material. From the comparative analysis of the remedial alternatives, Atlantic recommended the off-site landfill and off-site incineration as the superior remedial alternatives for overall protection of human health and the environment.

The Navy has decided to implement the installation of a cap over the landfill alternative. BRE is finalizing the remedial design and groundwater modeling reports for the cap.

1.2.3.26 Interim Remedial Action at DRMO (September, 1995)

Based on the Focused Feasibility Study for DRMO (Atlantic, March 1994) (Section 1.2.3.9), the Navy initiated an Interim Remedial Action at DRMO, Site 6, in 1994 with the off-site landfilling of contaminated soils and the installation of a cap. OHM Remediation Services Corporation was contracted by the Navy to perform the remedial tasks. These tasks included the removal and disposal of bituminous concrete, relocation of concrete barriers, excavation and disposal of lead- and PCB-contaminated soils, filling and grading, construction of a composite cap, installation of riprap, and installation of stormwater controls, including the installation of a drainage swale, site restoration work, and incidental work. Approximately 4,500 tons of lead-

contaminated soil and 200 tons of PCB-contaminated soil were disposed off-site at RCRA and TSCA landfills, respectively. In addition, approximately ten pounds of asbestos were disposed off-site. One hundred ninety cubic yards of non-hazardous bituminous concrete and 160 tons of scrap metal were sent off-site for recycling. Confirmatory samples were collected to determine the limit of excavation. After completion of the excavation of the contaminated soils, a composite cap approximately 43,000 square foot in area was installed over the DRMO with appropriate drainage controls. The work was completed with site restoration.

1.2.3.27 Soil Remediation at Spent Acid and Disposal Area (September, 1995)

Based on the Focused Feasibility Study for Spent Acid and Disposal Area (Atlantic, March 1994) (Section 1.2.3.10), the Navy initiated an Interim Remedial Action at the Spent Acid and Disposal Area, Site 15, in 1995 with the off-site landfilling of contaminated pavement, soils, tank materials, and tank contents. OHM Remediation Services Corporation was contracted by the Navy to perform the remedial tasks stated above and site restoration. Approximately 318 tons of contaminated material was properly disposed off-site, and the site was restored to operation.

1.2.3.28 Sampling Activities at Goss Cove Landfill and Nautilus Museum (October 1995)

The Navy initiated additional sampling at the Goss Cove Landfill and Nautilus Memorial Museum (Site 8) because of public concern for the possible unacceptable risks at the site reported in the Draft Phase II RI report. The additional sampling was conducted by BRE in July 1995 and consisted of the collection of four soil samples and two rounds of air sampling within and outside the museum. The letter report concluded that no unacceptable risks associated with exposure to the air or soil at Goss Cove exist.

1.2.3.29 Groundwater/Leachate Modeling Study for Area A Landfill Remedial Design (October 1996)

BRE conducted a Groundwater/Leachate Modeling Study for Area A Landfill Remedial Design to predict the impact of the proposed cover system on the saturated fill material, to compare slope stability effectiveness and cost, to predict the impact of the cover system on flow and composition of groundwater/leachate discharging from the landfill into the Area A Wetlands with and without a toe drain system. Ten infiltration tests were performed for this study. In addition, thirteen overburden and three bedrock monitoring wells, ten temporary piezometers, and eight staff gauges were installed. Eight soil samples were collected from the overburden monitoring wells and analyzed for geotechnical parameters. Slug tests were performed at eighteen wells and a synoptic round of water levels were conducted for hydrogeologic data. One seep sample was collected from the groundwater seep at OBDA pond and analyzed for volatile and semivolatile organics, pesticides, PCBs, and inorganics. One semivolatile compound (butylbenzylphthalate at 0.5J $\mu\text{g/L}$)

and six inorganics (calcium at 22,400 $\mu\text{g/L}$; iron at 2,760 $\mu\text{g/L}$; magnesium at 8,660 $\mu\text{g/L}$; manganese at 605 $\mu\text{g/L}$; potassium at 5,020 $\mu\text{g/L}$; and sodium at 46,800 $\mu\text{g/L}$) were detected in the seep sample.

Based on the results of the study, it was concluded that the Area A Landfill cover system will reduce the water table elevation below the landfill, provide acceptable stability, reduce contaminant migration from the unsaturated zone to the saturated zone by 97 percent, and reduce mass flux of contaminants of concern from the landfill to the Area A Wetland by 16 to 55 percent. In addition, it was concluded that the main mechanism for groundwater/leachate movement from the landfill to the wetland was lateral groundwater flow at the southern edge of the landfill. The report recommended not to modify the existing cover system design by adding a toe drain system.

1.2.3.30 Area A Landfill Design Analysis (December 1996)

BRE prepared an interim remedial design for the Area A Landfill. It included only a containment (capping) action. The interim remedial action is intended to mitigate contamination releases from the Area A Landfill and to prevent human exposure to the releases. The design was based on the previous Atlantic and HNUS studies.

Based on the design analysis, the report concluded the cap would provide sufficient stability and prevent groundwater infiltration.

1.2.3.31 Area A East End Investigation (December 1996)

BRE conducted an Area A East End Investigation to determine if landfill material existed below the Area A recreational facilities. A review of aerial photographs and base records and interviews with NSB-NLON personnel were conducted for the investigation. In addition, three soil borings were drilled around the tennis courts and six test trenches were excavated along the proposed eastern boundary of the Area A Landfill cap system. Six soil samples were collected from the soil borings and four soil samples were collected from four test trenches. All samples were analyzed for volatile and semivolatile organic compounds, total petroleum hydrocarbons, pesticides, PCBs, inorganics and cyanide.

Few volatile or semivolatile organics and inorganics were detected in the soil samples and were below CTDEP cleanup criteria. The report recommended not to extend the Area A Landfill remedial design of a multimedia cap system to include the Area A East End.

1.2.3.32 Focused Feasibility Study for the Area A Downstream / OBDA (December 1996)

In December 1996, BRE revisited the focused feasibility study for the Area A Downstream / OBDA which was originally prepared by Atlantic in 1994. The revised focused feasibility study addressed pesticide contamination in soils and sediment and evaluated potential remedial alternatives including; no action, removal of the OBDA and capping with institution controls, removal of the OBDA and excavation and offsite disposal of soils and sediment, and removal of the OBDA and excavation and onsite treatment of soil and sediment. The FS recommended that additional soil and sediment sampling be performed to select the most desirable remedial alternative for the site. After collection and evaluation of the data, a remedial alternative will be selected and documented in the record of decision for the site.

1.2.3.33 Functions and Values Assessment of the Area A Downstream (December 1996)

A functions and Values assessment of the Area A Downstream was performed by a subcontractor to BRE to support evaluation requirements of the Area A Downstream / OBDA focused feasibility study. The vegetative habitat of the Area A downstream watercourses were evaluated and the report concluded that based on the vegetation present, no adverse effects resulting from contamination were evident. The report further concluded that disturbance of the lower pond be minimized, since this water body has been impacted the least by human activity.

1.2.3.34 Tank Farm Site Investigation (February 1997)

BRE conducted an investigation from September to November 1995 of the UST farm along Crystal Lake Road. The primary objectives of the investigation were to define the extent of soil and groundwater contamination from the UST farm, evaluate the impact of the UST farm on the stormwater discharge, and recommend remedial alternatives, if needed. The investigation included subsurface geophysical surveys, soil boring and monitoring well installations, investigation of underground pipelines, sediment sampling, and surface water sampling. The report recommended remedial action at 5 of the UST sites, no further action at 6 of the UST sites, and further characterization at 2 of the UST sites.

1.2.3.35 Feasibility Study for the DRMO (February 1997)

BRE has prepared a feasibility study for the DRMO to address contamination in soil and groundwater. The feasibility study evaluated no action; Institutional controls and monitoring; excavation, offsite disposal, institution controls and monitoring; and excavation, ex situ treatment, and offsite disposal. The FS also

recommended that groundwater monitoring would be required to evaluate potential impacts. A remedial alternative will be selected and documented in the Record of Decision for the site.

1.2.3.36 Site Management Plan (February 1997)

BRE has developed the Site Management Plan for the NSB-NLON to be used as a tool to prioritize and rank sites for action. The Navy's relative risk ranking procedure was used to assign ranks of high, medium, and low to each site. Schedules for implementation of work were also included in the Site Management Plan. Future work activities will be conducted in accordance with the priority and schedules included in the plan.

1.2.3.37 Data Gap investigation report for the Goss Cove Landfill (March 1997)

BRE has conducted a data gap investigation at the Goss Cove Landfill to address the source of chlorinated compound contamination detected in the upgradient groundwater at the site. Borings and wells were installed and soil and groundwater samples were collected during the investigation. The results of the investigation concluded that chlorinated compounds are migrating onto the site from an upgradient, offsite, source. The report recommended that further groundwater characterization was required to address the contaminant source. The report also recommended that the upcoming FS for the Goss Cove should be prepared separately from the ongoing upgradient groundwater characterization activities.

1.2.3.38 Remedial Investigation Work Plan for the Lower Subase (March 1997)

BRE has prepared a work plan for a Remedial Investigation to be conducted at the Lower Subase. The Remedial investigation will be expanded to address those areas which were not previously evaluated in the Phase II RI as well as, those areas which were evaluated and recommended further characterization. The RI will include sampling of soil and groundwater, as well as surface water and sediment sampling in the Thames River in the vicinity of the Lower Subase.

1.2.3.39 Existing Summary Report for the Lower Subase (March 1997)

BRE has also prepared a compilation of data to support the development of the RI for the Lower Subase. The report assembled all available data and was used to scope all work components of the Lower Subase RI. The report recommended further characterization of the soil, groundwater, surface water, and sediment.

1.2.3.40 Abbreviated Field Verification Sampling activities for the Rubble Fill Area at Bunker A86 (Ongoing)

The Navy is in the process of removing the Rubble Fill area at Bunker A86 to accommodate installation of an upgradient interceptor trench, which is part of the remedial action at the Area A Landfill. Confirmation sampling will be conducted after the removal activity to verify that contaminated materials have also been adequately removed. A total of 14 surface soil samples are planned for collection during confirmation sampling.

1.2.3.41 Yearly Groundwater monitoring activities at the DRMO (ongoing)

The Navy is in the process of conducting a yearly monitoring program for the DRMO to support long term monitoring needs for the site. The program will consist of the collection groundwater samples from 10 monitoring wells on a quarterly basis, and yearly evaluation of the data to determine if long term impacts are evident.

1.2.4 Description of the Study Areas

Thirteen sites were investigated during the course of the Phase II RI. These sites included 10 of the 11 sites investigated by Atlantic (the former gasoline station was not studied). For the purposes of the Phase II RI, Area A was subdivided into four areas (Area A Landfill, Area A Wetland, Area A Weapons Center, and Area A Downstream Watercourses). The OBDA was combined with the Area A Downstream Watercourses based on geographic proximity. Brief descriptions of the various sites studied during the Phase II RI are provided in the remainder of this section.

1.2.4.1 Construction Battalion Unit Drum Storage Area - Site 1

The Construction Battalion Unit (CBU) Drum Storage Area is an unpaved area located in the northern section of NSB-NLON adjacent to the deployed personnel parking lot and the Area A Landfill. The site is situated on a flat, open area at the edge of a wooded hillside that slopes toward the site. The size of the site is approximately 15 feet in width by 30 feet in length. The location of this site is provided on Drawing 1 (Volume III). Additional information regarding the CBU Drum Storage Area is provided in Section 5.0.

1.2.4.2 Area A Landfill - Site 2

The Area A Landfill is located in the northeastern and north-central section of NSB-NLON and encompasses approximately 13 acres. The depth of the landfill deposits is approximately 10 to 20 feet, based on test

boring data generated during the Phase I and Phase II RIs. The Area A Landfill is a relatively flat area bordered by a steep, wooded hillside that rises to the south, a steep wooded ravine to the west and the Area A Wetland to the north. The location of the Area A Landfill is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 6.0.

1.2.4.3 Area A Wetland - Site 2

The Area A Wetland is adjacent to the north side of the Area A Landfill and is approximately 23.6 acres in size. This portion of NSB-NLON was undeveloped, wooded land until the late 1950s. In the late 1950s, dredge spoils from the Thames River were pumped to this area and contained within an earthen dike that extends from the Area A Landfill to the south side of the Area A Weapons Center. Based on the boring logs, the total volume of dredged material in the wetlands is approximately 1.2 million cubic yards. The location of the Area A Wetland is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 7.0.

1.2.4.4 Area A Weapons Center - Study Area 20

The Area A Weapons Center site consists of Building 524 and weapons storage bunkers. The storage bunker area is divided into two portions (north and south areas) which were constructed at different time and are of different design. The site is located at the end of Triton Avenue to the north and is adjacent to the Area A Wetland. The location of the Area A Weapons Center site is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 8.0.

1.2.4.5 Area A Downstream Watercourses and OBDA - Site 3

The Area A Downstream Watercourses drain the Area A Landfill and Wetland and ultimately flow into the Thames River. The Area A Downstream Watercourses include North Lake and several small ponds with interconnected streams which discharge from Area A and the Torpedo Shops. The location of the Area A Downstream Watercourses and the OBDA is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 9.0.

1.2.4.6 Rubble Fill at Bunker A-86 - Site 4

Bunker A-86 is located on a gravel road off Wahoo Avenue in the north central section of NSB-NLON. The Area A Landfill is adjacent to the site to the north, and the Subbase hazardous waste storage facility is adjacent to the site to the south. The Rubble Fill Area is located north of the dirt road and west of the

bunker. The site is approximately 25 feet wide and 60 feet long. The site is on a wooded hillside that slopes to the north-northeast. The location of the Rubble Fill Area is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 10.0.

1.2.4.7 Defense Reutilization and Marketing Office (DRMO) - Site 6

The DRMO is adjacent to the Thames River in the northwestern section of NSB-NLON. The DRMO is the storage and collection facility for items to be sold at auctions and sales held periodically throughout the year. The land is relatively flat, low-lying and prone to flooding. The southern half of the DRMO is covered with asphalt, some of which is deteriorated. The northern portion of the DRMO was previously unpaved. An interim remedial action was recently completed at this site and included soil removal, backfilling, and encapsulation. The location of the DRMO site is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 11.0.

1.2.4.8 Torpedo Shops - Site 7

The Torpedo Shops (torpedo overhaul and assembly) are located in the northern portion of NSB-NLON on the north side of Triton Avenue. The site is bounded to the east and north by 60-foot-high bedrock cliffs. The remainder of the site slopes to the southwest. An earthen berm extends along the base of the eastern portion of the exposed rock face. Surface runoff from the site flows southwest to drainage swales and storm sewers located on the south side of Buildings 325 and 450. Runoff contained by the berm, as well as the storm sewer system, drains through culverts under Triton Avenue into the Area A Downstream Watercourses and eventually discharges to the Thames River. The location of the Torpedo Shops is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 12.0.

1.2.4.9 Goss Cove Landfill - Site 8

The Goss Cove Landfill is located in the southwestern portion of NSB-NLON, adjacent to the Thames River. It is west of the intersection of Crystal Lake Road and Military Highway, east of the Thames River and north of Goss Cove. The Nautilus Museum and a paved parking lot are constructed directly over the site of the former landfill. The Nautilus Museum is a submarine museum operated by the Navy which is open to the public. The location of the Goss Cove Landfill is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 13.0.

1.2.4.10 Lower Subase

The Lower Subase site is bounded on the west by the Thames River and to the east by the Providence and Worcester Railroad tracks. The Lower Subase extends from and includes Building 29 (Power Plant) in the north to Building 85 in the south. The Lower Subase is the original naval base and its use dates from 1867. Most of the construction at the Lower Subase took place in the early 1900s with a major expansion from 1935 to 1940. Based on previous investigations, potential sources of fuel oil contamination have been identified at the Lower Subase. The location of the Lower Subase is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 14.0.

1.2.4.11 Over Bank Disposal Area Northeast (OBDANE) - Site 14

The OBDANE is located in a heavily wooded area on the edge of a ravine northwest of the Area A Landfill and south of the Torpedo Shops. A dirt road provides limited access to the wooded site. A nearly vertical 20-foot-high bedrock face is located at the eastern edge of the site. The rest of the site slopes to the southwest. Surface runoff flows to the southwest into a stream which flows from the Area A wetland. The location of the OBDANE is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 15.0.

1.2.4.12 Spent Acid Storage and Disposal Area (SASDA) - Site 15

The SASDA is located in the southeastern section of NSB-NLON between the southern side of Buildings 409 and 410. The site is a relatively flat area completely covered with concrete or bituminous pavement. A catch basin and storm sewers collect surface runoff which is directed to the south and ultimately discharges to the Thames River at Goss Cove. A soil removal action and capping were recently completed at this site. The location of Site 15 is shown on Drawing 1 (Volume III). Additional information regarding the site is provided in Section 16.0.

1.2.4.13 Thames River

The Thames River is a tidal, salt-wedge estuary formed at the confluence of the Shetucket and Yantic Rivers in Norwich, Connecticut. The river flows south approximately 16 miles to Long Island Sound. NSB-NLON and the town of Groton are on the east bank of the river approximately 6 miles north of Long Island Sound. The town of Groton extends from the southern boundary of NSB-NLON to Long Island Sound. The City of New London is located on the west bank of the river. Land development along the southern portion of the river is primarily industrial. Chemical companies, oil terminals, power plants, and waste water treatment

plants occupy both banks of the river. The location of the Thames River is shown on Drawing 1 (Volume III). Additional information regarding the Thames River is provided in Section 17.0.

1.3 REPORT ORGANIZATION

This Phase II RI Report has been organized with the intent of: (1) meeting the general format requirements specified in the October 1988 RI/FS guidance document (USEPA, October 1988) and (2) summarizing the results of the RI for the 13 separate sites in a cohesive and comprehensive manner. According to the RI/FS guidance document, a Remedial Investigation (RI) report should typically consist of seven separate sections, including an introduction, a summary of the site investigation, a description of the site physical conditions, a summary of the nature and extent of contamination, a contaminant fate and transport analysis, a baseline risk assessment, and summary and conclusions.

While this format is appropriate for a site consisting of a limited number of operable units or individual study areas, it is not particularly well suited for an RI report addressing 13 separate, noncontiguous sites or areas. Therefore, this RI report has been structured such that some continuity exists for each of the individual sites or areas. Specifically, some sections provide general information that is common to all of the sites, while others present information relevant only for a specific site.

Section 1.0, Introduction, summarizes the purpose of the report, provides general base background information, summarizes previous investigations, and provides the report outline. Section 2.0, Study Area Investigations, provides a summary of investigative procedures (e.g., soil sampling and analysis, groundwater sampling and analysis, water level measurement, characterization of hydrogeologic characteristics, surface water and sediment sampling procedures and analytical methods, etc.) that are common to each of the thirteen study areas.

While Sections 1.0 and 2.0 are generally consistent with the format required by the RI/FS guidance document, Section 3.0, General Data Evaluation Procedures, is an additional section that deals with data analysis and interpretation methods that are common to all of the sites. Section 3.0 includes a discussion of data validation procedures, general contaminant fate and transport characteristics (e.g., chemical and physical properties, persistence, and environmental mobility), and human health and the environmental risk assessment components such as data evaluation, toxicity assessment, exposure assessment, etc. that are used repeatedly for each of the eleven sites. The inclusion of this information in one stand-alone section is designed to eliminate repetition of such general procedures throughout the body of the report and to maintain continuity for the individual sites discussed in subsequent sections.

Section 4.0, General Physical Characteristics of NSB-NLON, conforms to the typical Section 3.0 of an RI report. However, this section is macroscopic in nature in that it addresses basewide features such as topography, climate and meteorology, hydrology, geology, etc. Additional, site-specific discussions of these physical characteristics are provided in study area-specific sections of the report.

Sections 5.0 through 17.0 focus on site-specific studies and include detailed information regarding each of the individual sites. These sections of the report are designed to be site-specific, stand-alone sections in that they include a description of the site, a summary of the site-specific field investigation, a description of site-specific physical characteristics, nature and extent of contamination, site-specific contaminant fate and transport, a baseline human health and ecological risk assessment, and individual summary and conclusions.

Section 18.0 includes an overall summary, conclusions, and recommendations for all of the sites. All full-size drawings are included in Volume III of this report. Supplemental information for this report is included in Appendices A through I in Volumes IV through XIII.

TABLE 1-1

**SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT**

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database				
NESO 1-026 "Oil Contamination of Groundwater At Subase New London, CT" Naval Environmental Support Office February 11, 1979	Building 29 (Power Plant Oil Tanks, Area 1)	Lower Subase, Site 11	Soil Groundwater	38 16	Oil/Grease	Source of contamination at Site 11 is the heated day storage tank and the reclamation tank behind the power plant	Inspection of tanks and storm sewers and repair as necessary	No				
	Building 107/345 (Oil Storage Tanks, Area 2)	Lower Subase, Site 10				Site 10 poses no environmental threat	Monitor adjacent well regularly					
	Building 79 (Waste Oil Pit, Area 3)	Lower Subase, Site 13				Site 13 contaminated with oil originating from abandoned exfiltration well or basin	Install well system to remove oil from the soil					
Final Initial Assessment Study of Naval Submarine Base New London, CT NEESA 13-025 Envirodyne Engineers, Inc. March, 1983	CBU Drum Storage Area, Site 1	CBU Drum Storage Area, Site 1	Visual investigation and research of site history	None	NA ⁽¹⁾	Low potential for contributing contaminants to the environment because source of contamination has been removed, or site is no longer in use	No further action	NA				
	Goss Cove Landfill, Site 8	Goss Cove Landfill, Site 8										
	Building 79 Waste Oil Pit, Site 13	Building 79 Waste Oil Pit, Site 13										
	Spent and Storage and Disposal Area, Site 15	Spent and Storage and Disposal Area, Site 15										
	Area A Landfill Site 2	Area A Landfill Site 2										
	Overbank Disposal Area, Site 3	Area A Downstream Watercourses and OBDA, Site 3				Source of contamination still present and potentially releasing contaminants to the environment	Sample surface water and sediment					
	Rubble Fill at Bunker A-86, Site 4	Rubble Fill at Bunker A-86, Site 4					Sample surface water and sediment					
	DPDO Area, Site 6	DRMO Area, Site 6					Post no dumping signs					
							Drill soil borings					

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Initial Assessment Study (Continued)	Fuel Oil Storage Tanks, Site 10	Lower Subase, Site 10					Monitor level of oil in tanks to see if leaking	
	Power Plant Oil Tanks Site 11	Lower Subase, Site 11					Replace tanks, implement oil recovery	
	Overbank Disposal Area Northeast, Site 14	Overbank Disposal Area Northeast, Site 14					Post no dumping signs	
Final Site Investigation Subsurface Oil Contamination - Lower Subase Naval Submarine Base - New London, Groton, Connecticut Wehran Engineering Corporation, November 1987	Building 29 (Power Plant Oil Tanks, Area 1)	Lower Subase, Site 11	Soil Sludge Groundwater	10 9 7	Oil/PCBs	Soluble constituents of oil are present throughout the study area: <ul style="list-style-type: none"> Manholes and groundwater in the vicinity of Building 29 and 345 contaminated with #6 and #5 fuel oil Manholes, soils, and groundwater in the vicinity of Building 79 contaminated with #6 fuel oil Utility trench from Building #85 to #78 contaminated with #6 fuel oil 	Additional study of oil distribution in Building 29	No
	Building 107/345 Oil Storage Tanks (Area 2)	Lower Subase, Site 10					Mopping sludge oil and excavation of oil-laden soils	
	Building 79 (Waste Oil Pit, Area 3)	Lower Subase, Site 13					Inspection of the #6 fuel oil line and cleaning of trench	

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Verification Step 1A Study Naval Submarine Base - New London, Wehran Engineering Corporation February 1988	Area A Landfill and OBDA	Area A downstream water courses OBDA, Site 3 Area A Wetland, Site 2 Area A Landfill, Site 2	Surface Water Sediment	18 18	VOC ⁽²⁾ BNA Pest/PCB Metals	The soils of DPDO and surface waters and sediments of Area A have levels of contaminants hazardous to public health and the environment	Site Characterization Step 1B Study, hydrogeological investigation, should be performed for both locations	No
	DPDO	DRMO, Site 6	Soil	3				
North Lake Water Quality Measurements 1988-1993	North Lake	Within the Area A downstream watercourses, Site 3	Surface Water Soil/Beach Sand	2 30	Pest/PCBs, cyanide, halogenated volatile organics, metals, aromatic volatile organics, phthalate esters, EP toxicity	<ul style="list-style-type: none"> Sporadic detections of various metals in the beach sand Intermittent low-level detection of volatiles in surface water No detections of pesticides or PCBs 	NA	Selected Samples
Data Report - Additional Borings Conforming Storage Facility, Groton, CT Prepared for Donohue and Associates, Inc. Prepared by Goldberg-Zoino & Associates, Inc. August 1989	Future site of the conforming storage facility, located within the DRMO area	DRMO, Site 8	Soil	3 Composite	Priority pollutant Metals EP Toxicity TCLP Metals ⁽³⁾	<ul style="list-style-type: none"> Most inorganics analyzed were detected 7 of 13 metals were detected above the minimum detection limit for the TCLP metals analysis 8 of 8 metals were detected above the minimum detection limit for the EP TOX metals analysis Acetone, methylene chloride, 4-methyl-2-pentanone detected for TCLP VOC 	Not given	No

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Data Report (Continued)				4 Grab 3 Composite	TCLP VOCs	<ul style="list-style-type: none"> Carbon disulfide and pyridene were detected once in two different samples Acetone, methylene chloride, and 4-methyl-2-pentanone were detected in the same concentration range as the lab blank 		
Hydrogeologic Investigation Underground Storage Tanks OT-4, OT-7, OT-8, OT-9, and 54-H U.S. Naval Submarine Base New London Groton, Connecticut Fuss & O'Neill, Inc. September 1989	Upper Base Fuel Farm OT-4, OT-7, OT-8, OT-9	None	Soil Groundwater	4 12	Volatile aromatics, Petroleum Scan (Coast Guard Method)	<ul style="list-style-type: none"> Impacts have occurred as a result of petroleum handling at the site No. 2 fuel oil detected in soil OT-4 No. 2 fuel oil found in 10 groundwater monitoring wells Volatile aromatics found in 4 groundwater monitoring wells 	With data available cannot determine if tanks are leaking or the associated piping and appurtenances	No
	Lower Base Tank 54-H	Lower Base, Site 10	Groundwater	4				

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included In the Database
Multi-media Inspection, Naval Submarine Base-New London, Groton, Connecticut USEPA, Region I, August 8, 1991	Various locations for air inspection	Torpedo Shops, Site 7 Lower Subase	Spray paints Varnish	3 1	VOC	NSB-NLON in violation of CTDEP metal parts and products regulations	None	No
	Various locations for TSCA inspection	Lower Subase	None	NA	NA	Various PCB spills and storage problems	Correct problems	NA
	Various locations for RCRA inspection	Torpedo shops, Site 7 Lower Subase	None	NA	NA	Various deficiencies in container storage area, inspections, documentation, waste manifests, contingency plan, and spill prevention, control, and counter measures	Correct problems	NA
	Various locations for Clean Water Action inspection	DRMO, Site 6 Lower Subase	Sediment	3	Unknown	Results pending	To be provided	No
			Surface water	1	Unknown			
			Industrial/sanitary discharge	2	VOC metals			
	CBU Drum Storage, Site 1	CBU Drum Storage, Site 1	Soil Sediment Groundwater Surface Water	242	TCL VOC TCL SVOC ⁽⁵⁾ TCL Pest TCL PCB TAL Metals Gross Alpha Gross Beta Full TCLP TPH ⁽³⁾ TSS ⁽⁴⁾	Low conc., do not cause risk to health or environment	Perform a supplemental Step I investigation	Yes
Phase I Remedial Investigation Naval Submarine Base New London Atlantic Environmental Services, Inc. August 1992	Rubble Fill at Bunker A-86, Site 4	Rubble Fill at Bunker A-86, Site 4				Potential health risks	Proceed to Step II of the IR Program	
	Torpedo Shops, Site 7	Torpedo Shops, Site 7				Health risks negligible. No significant ecological risks	Proceed to Step II of the IR Program	

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Phase I Remedial Investigation (Continued)	Goss Cove Landfill, Site 8	Goss Cove Landfill, Site 8			Bird/Frog Livers	Potential risk to construction workers	Proceed to Step I of the IR Program	
	OBDANE, Site 14	OBDANE, Site 14				Negligible risk	Perform a supplemental Step I investigation	
	Spent Acid Storage Area, Site 15	Spent Acid Storage Area, Site 15				Risk to construction worker could be unacceptable	Proceed to Step II of the IR program	
	Former Gasoline Station at Dealy Center	Not Investigated				No risks identified based on available data	Do not proceed with Step II, remove UST and perform corrective actions as necessary in accordance with UST regulations	
	Area A, Site 2	Area A, Downstream Watercourses, Site 3, Landfill, Site 2, Weapons Center, Site 20, Wetland, Site 2				Several exposure scenarios exceed acceptable level	Proceed to Feasibility Study Phase	
	OBDA, Site 3	Area A, Downstream Watercourses, Site 3					Proceed to Feasibility Study Phase	
	DRMO, Site 6	DRMO, Site 6				Concentrations in groundwater below water quality criteria	Proceed to Feasibility Study Phase	
	Lower Subase, Site 13	Lower Subase				Groundwater exceeds drinking water standards	Proceed to Feasibility Study Phase	

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Draft Focused Feasibility Study Defense Reutilization Marketing Office Installation Restoration Program Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. March 25, 1994	DRMO, Site 6	DRMO, Site 6	Soil	23	TCL VOC TCL SVOC TCL Pest TCL PCB TAL Metals TCLP VOC TCLP SVOC TCLP Metals TCLP Pest Dioxin	<ul style="list-style-type: none"> • TCE⁽⁶⁾, 1,2,-DCA⁽⁷⁾, and toluene TBC⁽⁸⁾ values were exceeded • SVOCs predominantly PAHs, were detected across the site • PCBs were detected in nearly all borings • Pesticides were detected at many locations primarily at low concentrations, however several were detected at high concentrations • Most inorganics detected at elevated concentrations, however, lead was of primary concern 	<ul style="list-style-type: none"> • Off-site landfill provides superior protection of the environment • Provides permanent solution to source area 	Yes
Draft Focused Feasibility Study Spent Acid Storage Facility Installation Restoration Program Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. March 29, 1994	Spent Acid Storage and Disposal Area	Spent Acid Storage and Disposal Area Site 15	Soil	6	TCL VOC TCL SVOC TCL Pest TCL PCB TAL Metals TCLP VOC TCLP SVOC TCLP Metals TCLP Pest	<ul style="list-style-type: none"> • No VOCs were detected • SVOCs, predominantly PAHs, detected across the site • PCBs detected at one location at low-levels • Pesticides detected at low levels • Several inorganics detected above background, predominantly lead 	<ul style="list-style-type: none"> • Offsite landfill provides superior protection of the environment, is easiest to implement, and is most cost-effective 	Yes

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Draft Focused Feasibility Study Area A Downstream/ OBDA Installation Restoration Program Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. April 5, 1994	Area A Downstream/OBDA	Area A Downstream/OBDA	Surface Soil Sediment Bioaccumulation In Native Soil Invertebrate Insitu Bioassay of Earth Worms Laboratory Earthworm Bioassay with Sediment	18 60 5 18 8	TCL VOC TCL SVOC TCL Pest TAL Metals TCL PCB Full TCLP TCL Pest NA NA	<ul style="list-style-type: none"> • DDTR detected in all of the soil samples. • VOC and SVOCs were not detected in the sediments • Pesticides were detected in all of the 15 sediment samples • No PCBs were detected in sediments • Levels of organics are above background in several locations • Lower pond and the eastern end of OBDA pond exhibits high toxicity to invertebrate • Upper pond and the western end of OBDA pond exhibit moderate to high toxicity to invertebrate • Rest of areas studied exhibit low to moderate toxicity and support invertebrates 	<ul style="list-style-type: none"> • Offsite landfill and onsite thermal desorption provide superior protection of environment • Offsite landfill slightly more cost effective 	Yes

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Off-site residential well water Data Evaluation Report, Installation Restoration Program, Naval Submarine Base - New London, Groton, Connecticut, Atlantic Environmental Services, Inc., July 1994	Off-site residential water wells	None	Groundwater	175	TCL VOC TCL SVOC TCL Pest/PCB TAL Inorganics Boron Cyanide Chloride	<ul style="list-style-type: none"> Organic compounds were only detected during first round of sampling Several instances of elevated levels of inorganics detected 	Preliminary conclusion that off-site residential water wells not being impacted by NSB-NLON	Yes
Environmental Assessment for Pier 17 Replacement, Naval Submarine Base New London, Groton Connecticut, Prepared for: Department of the Navy, Commander-In-Chief, U.S. Atlantic Fleet, Norfolk, Virginia, Prepared by: Maguire Group Inc. September 1994	Pier 15	None	Sediment	24	Metals PAHs	<ul style="list-style-type: none"> Higher concentrations of metals and PAHs in upper sediment strata than lower strata Pesticides and PCBs detected in low levels in upper sediment strata Mercury and nickel exceeded marine USEPA water quality criteria 	The proposed action will have short-term effects on Thames River water quality, no effects on navigation, and minimal effects on fish and benthic species	No
	Pier 17		Surface Water	3	Elutriate test			
			Fish and Benthic Species	5	Toxicity test and Taxonomy study			

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Post-Removal Action Report for Building 31 Lead Remediation Naval Submarine Base - New London Groton, Connecticut Halliburton NUS Corporation January, 1995	Building 31	Lower Subbase, Site 17	Excavation Soil Samples Solidified Soil Samples Wipe Samples	57 54 27	Total Lead TCLP Lead Total Lead	The final sample results showed that the walls of the excavation were no longer contaminated or the excavation reached the mean low tide elevation (maximum excavation depth). Albacore Road could not be completely excavated due to operational concerns of the Base. The sampled concrete surfaces were either not contaminated or were adequately decontaminated	No further excavation was required for most areas of site. Navy to defer continued remediation at Albacore Road	No
Federal Facilities Agreement under CERCLA, Naval Submarine Base New London, Connecticut January 11, 1995		Numerous sites	None	None	None	None	Regulatory tool for implementation of IR work	NA

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Site Inspection Report Pier 33 and Berth 16/Former Incinerator Installation Restoration Study Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. February, 1995	Pier 33 and Berth 16/ Former Incinerator	Portions of the Pier 33 Study Areas is located Berth 16 is not located in the formal boundaries of the Lower Subbase site used in the RI, however, Berth 16 is proximate to Site 13	Soil Sediment Groundwater	43 4 9	TAL/TCL Parameters TPH TCLP Metals Dioxin	<ul style="list-style-type: none"> • VOCs concentrations detected in the soils are not considered to be significant • Elevated concentrations of TPH were detected • No significant concentrations of pesticides or PCBs were detected • Groundwater quality at the site is generally good and does not exceed ARARs except for lead in one well • Dioxin was detected in one location 	Remedial investigation is recommended for both Pier 33 and Berth 16	No
Draft Final Supplemental Site Investigation Area A Landfill Installation Restoration Program Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. March 1995	Area A Landfill	Area A Landfill, Site 2	Soil Bituminous Concrete	13 4	TCL VOC TCLP VOC TCLP SVOC TCL Pest TCLP Metals TCL PCB TCLP Pest TAL Metals Dioxin	<ul style="list-style-type: none"> • Dioxin detected in borings below screening level • Inorganic detections above background • Pesticides, VOCs and SVOCs detected across site 	<ul style="list-style-type: none"> • Dioxin considered to not be a chemical of concern • Inorganics do not appear to be a concern at the site 	Yes

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Background Concentrations of Inorganics in Soil Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. April, 1995	Undisturbed Areas of NSB-NLON	None	Soil	18	TCL VOC TCL SVOC TCL Pest/PCB TAL Metals Cyanide Boron	<ul style="list-style-type: none"> All site-derived background levels are within the ranges published by the USGS for background levels for the eastern United States Based on the organic compounds detected, it is concluded that all samples locations are representative of native background conditions 	Background levels of inorganics were established to screen site analytical data to identify areas where releases of pollutants may have occurred	Yes
Site Characterization Report for OT-10, Building 325, and Building 89 Naval Submarine Base - New London Groton, Connecticut Halliburton NUS Corporation April 1995	OT-10	None	Soil Groundwater	12 8	TPH, BTEX TAL/TCL Parameters	TPH does not exceed CTDEP industrial cleanup standards. Generally low level detections of other contaminants are typical of site wide conditions and may not be associated with the tanks in question	No further action	Building 325 data only
	Building 325, Tanks R01R1 and R02	Torpedo Shops, Site 7	Soil Groundwater	11 4	BTEX, TPH	There is possible petroleum related contamination in the soils surrounding these tanks. The groundwater detection was below state industrial cleanup standards	Soil recently removed. No further action.	

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Site Characterization Report (Continued)	Building 89, Tank Z01	Site is not located in the formal boundaries of the Lower Subase site used in the RI; however, Building 89 is proximate to the Lower Subase site	Soil	3 1	BTEX, TPH Lead, TPH, Volatile Aromatics	Analytical results indicate soils in the vicinity of tank Z01 have detected contaminants below state cleanup levels Groundwater has been impacted by a petroleum related source	Due to the possibility of the groundwater contamination originating from another source, and because the Lower Subase is being investigated as part of the RI, no further action is recommended	
Preliminary Assessment, Draft Final PA-13-025A-ENV Supplement to Initial Assessment Study NEESA 13-025 Naval Submarine Base New London Groton, Connecticut April, 1995	DRMO Building 355	DRMO Site 8	Visual Investigation and Research of Site History		Lead sample results from a previous investigation are referenced for Tanks 99 and 326	Not a hazardous waste storage facility	No further action	No
	Building 450 OTTO Fuel Wastewater Tank	Torpedo Shops, Site 7				Tank was cleaned and backfilled in 1987	Included in the Phase II RI	
	Building 450 Drum Storage Area	Torpedo Shops, Site 7				90-Day Hazardous Waste Accumulation area	No further action	
	Pesticide Use Golf Course	Area A Downstream Water Courses, Site 3				Operational	Additional investigations are recommended	
	Pesticide Use Public Works	None				Operational	No further action	
	Transformer at Building 157, Vault 31	None				Oil on concrete pad surface, potential for PCBs	No further action under the cleanup recommended under the spill cont. plan	
	Paint Residue, from Repairing Potable Water Tank 99	None				Sample results indicate soil contaminated with lead	Further investigation recommended	
	Paint Residue, from Repairing Potable Water Tank 326	None				Sample results indicate soil contaminated with lead	Further investigation recommended	

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Preliminary Assessment, Draft Final (Continued)	Paint Residue, from Repairing Potable Water Tank 444	None				Possible soil contamination around tank from paint residue	Sampling is recommended to determine possible soil contamination	
	Paint Residue, from Repairing Potable Water Tank 452	None				Possible soil contamination around tank from paint residue	Sampling is recommended to determine possible soil contamination	
	Paint Residue, from Repairing Potable Water Tank 480	None				Possible soil contamination around tank from paint residue	Sampling is recommended to determine possible soil contamination	
	DRMO Scrap Metal Area	Proximate to DRMO, Site 6				Area formerly used to store scrap metal	Additional investigations are recommended	
	Hazardous Waste Accumulation Areas	Various				No evidence of releases found	No further action	
Geotechnical Field Investigation Report for Area A Landfill Remedial Design for Naval Submarine Base New London Groton, Connecticut Halliburton NUS Corporation May 1995	Area A Landfill	Area A Landfill, Site 2	Soil	3	TCL VOC, SVOC TCL Pest TCL PCB TAL Metals Cyanide	Subsurface locations are essentially non-contaminated	None	Yes

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Removal Site Evaluation for Quay Wall for Naval Submarine Base New London Halliburton NUS Corporation May 1995	Quay Wall	Lower Subbase	Soil	5	BTEX TCLP Metals TCL VOC TCLP VOC TCL SVOC Total PCB TAL Metals Cyanide TPH	<ul style="list-style-type: none"> Lead and arsenic detected above CTDEP regulatory standard VOC, SVOC, and pesticides below regulatory CTDEP standards No PCBs detected TPH detected in all soils but not in exceedence of CTDEP standards 	No further removal actions are recommended but further study needed	No
Final Letter Report Area A Landfill/ Wetland Interface Sampling Results Appendix C of the FFS for Area A Landfill Halliburton NUS Corporation May 24, 1995	Area A Wetland	Area A Wetland, Site 2	Sediment	20	TOC TCL VOC TCL SVOC TCL Pest TCL PCB TAL Metals	<ul style="list-style-type: none"> Several detections of VOCs Wide variety of SVOCs detected Wide variety of pesticides detected One PCB detected Numerous detections of low-level inorganics 	<ul style="list-style-type: none"> VOC origin is the landfill Primary source of SVOCs may not be the landfill but the paved parking lot Pattern of inorganic data results is indicative of background concentrations for most inorganics 	Yes
Final Focused Feasibility Study Area A Landfill Installation Restoration Program Naval Submarine Base - New London Groton, Connecticut Atlantic Environmental Services, Inc. May 26, 1995	Area A Landfill	Area A Landfill, Site 2	Refer to Phase I RI, Supplemental Site Investigation for Area A Landfill, and Area A Landfill/Wetland interface sampling results.				<ul style="list-style-type: none"> Off-site landfill and off-site incineration provide superior protection of environment Off-site Landfill is more cost effective than incineration 	NA

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Report of Interim Remedial Action Site 6, Naval Submarine Base New London Groton, Connecticut (DRMO) OHM Remediation Services Corp. September 6, 1995	DRMO	DRMO, Site 6	Soil	79	TCL VOC TCL SVOC TCL Pest TCL PCB TAL Metals Full TCLP analysis	Sample results were used primarily to confirm the limit of excavation, because of time constraints the excavation was terminated and backfilled prior to excavating all soils that exceeded the preliminary remediation goal	Site was backfilled and a cap installed	Yes
Final Report for Soil Remediation Spent Acid Storage and Disposal Area New London Naval Submarine Base Groton, Connecticut OHM Remediation Services Corp September 8, 1995	Spent Acid Storage and Disposal Area	Spent Acid Storage and Disposal Area, Site 15	Soil	5	Total Lead TCLP Lead	Sample results were used primarily to confirm the limit of excavation of contaminated soils	Site was excavated, sampling confirmed that contamination in exceedence of preliminary remediation goal was removed	Yes
Draft Summary Report of Sampling Activities, Analytical Results, and Supplemental Risk Assessment at Goss Cove Landfill and Nautilus Museum Brown & Root Environmental October 20, 1995	Goss Cove Landfill and Nautilus Museum	Goss Cove Landfill, Site 8	Soil	3	TAL/TCL Parameters	No VOCs were detected in the soil, 18 SVOCs were detected in the soils, Two pesticides and one PCB were detected, 20 inorganics were detected	No adverse health effects are anticipated for adult visitors, child visitors, or employees of the Nautilus Museum	Yes
			Air	4	Selected Volatile Organics	Acetone was the only detected volatile in the air in the Nautilus Museum Below the TWA ⁽⁸⁾		

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Groundwater/Leachate Modeling Study Report for Area A Remedial Design, Naval Submarine Base New London Groton Connecticut, Brown & Root Environmental October 1996	Area A Landfill	Area A Landfill, Site 2	Soil Groundwater Seep	8 1	Geotechnical parameters TAL/TCL parameters	<ul style="list-style-type: none"> Water table below landfill will be reduced with cover system Cover system will be stable Contaminant migration from unsaturated to saturated zone will be reduced Mass flux of contaminants of concern from landfill to wetlands will be reduced The main mechanism for groundwater/leachate movement from landfill to wetlands is lateral groundwater flow One detection of organic and six detections of inorganics in seep sample 	Do not modify existing cover system design with toe drain system	No
Draft Design Analysis Report for Area A Landfill for Naval Submarine Base, New London Groton Connecticut, Brown & Root Environmental December 1996	Area A Landfill	Area A Landfill, Site 2	None	None	None	Cap would provide sufficient stability and prevent groundwater infiltration into the landfill	None	NA

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Final Area A East End Investigation Report for Area A Landfill Remedial Design, Naval Submarine Base, New London, Groton, Connecticut Brown & Root Environmental, December 1996	Area A East End	Area A Landfill, Site 2	Soil	10	TCL VOC TCLs VOC TCL Pest TCL PCB TAL Metals TPH Cyanide	<ul style="list-style-type: none"> Few detections of volatile and semivolatile, and inorganics Results below CT DEP cleanup criteria 	The proposed Area A Landfill multimedia cap system should not include the Area A east end	No
Revised Draft Focused Feasibility Study for Area A Downstream/OBDA (Site 3), Naval Submarine Base, New London, Groton, Connecticut, Brown & Root Environmental, December 1996	Area A Downstream/OBDA	Area A Downstream/OBDA, Site 3	Soil and Sediment	None	None	Evaluated <ul style="list-style-type: none"> No Action Removal of OBDA and capping with institutional controls Removal of OBDA and excavation and offsite disposal of soil/sediment Removal of OBDA and excavation and onsite treatment of soil/sediment 	Additional soil and sediment sampling Further ecological and human health risk assessment	NA
Functions and Values Assessment of Area A Downstream Wetlands and Watercourses, Naval Submarine Base New London, Groton, Connecticut, William A. Niering and A. Hunter Brawley, December 20, 1996	Area A Downstream Watercourses	Area A Downstream/OBDA, Site 3	Vegetation of Downstream Watercourses	None	None	Vegetation present shows no adverse effects of contaminants	Disturbance of Lower Pond should be minimized, less concern with other areas	NA

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Site Investigation Report for Tank Farm Investigation Naval Submarine Base - New London Groton, Connecticut Brown & Root Environmental February 1997	Tank Farm	The investigation of the pipelines from the Tank Farm include a portion of the Lower Subbase Site	Sediment Soil Surface Water Groundwater	12 145 3 122	TAL/TCL Parameters TPH	TPH and inorganics identified as COCs	<ul style="list-style-type: none"> • Perform remedial action at 5 sites • Perform No Further Action at 6 sites • Perform further characterization at 2 sites. 	No
Feasibility Study for DRMO, Naval Submarine Base, New London, Groton, Connecticut, Brown & Root Environmental, February 1997	DRMO	DRMO, Site 6	Soil and Groundwater	None	None	Evaluated <ul style="list-style-type: none"> • No action • Institutional controls and monitoring • Excavation, offsite disposal, institutional controls and monitoring • Excavation, ex situ treatment, and offsite disposal 	Groundwater monitoring to be conducted	NA

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Site Management Plan for Naval Submarine Base, New London, Groton, Connecticut, Brown & Root Environmental, February 1997	CBU, Area A Landfill, Area A Wetland, Area A Downstream and Overbank Disposal Area, Rubble Fill at Bunker A-86, DRMO, Torpedo Shops, Goss Cove Landfill, Oil Wastewater Tank (OT-5), Lower Subbase (Fuel Storage Tanks and Tank 54-H, Power Plant Oil Tanks, Building 79 Waste Oil Pit, Building 31, Building 316, Berth 16, Pier 33, Building 174, and Classified Materials Incinerator), OBDANE, SASDA, Hospital Incinerator, Building 33, Area A Weapons Center, and Fuel Farm	CBU, Area A Landfill, Area A Wetland, Area A Downstream/OBDA, Rubble Fill at Bunker A-86, DRMO, Torpedo Shops, Goss Cove Landfill, Lower Subbase, OBDANE, SASDA, and Area A Weapons Center	None	None	None	Ranks of high, medium or low were developed for each site using Navy's relative risk ranking procedure. Detailed schedules summarizing planned remedial activities were also provided	Results of relative risk site evaluation will be used, in conjunction with other risk management information, to assist in sequencing remedial work. Activities will proceed following the schedules included. The SMP will be updated yearly.	NA
Data Gap Investigation Report for Goss Cove Landfill, Naval Submarine Base, New London, Groton, Connecticut, Brown & Root Environmental, March 1997	Goss Cove Landfill	Goss Cove Landfill, Site 8	Soil Groundwater	5 7	TCL VOC TCL VOC+ Geochemistry	Source of chlorinated compounds is not in vicinity of wells 8MW8S/8MW8D Chlorinated compounds in groundwater are migrating onto the Goss Cove landfill from a southeast direction	Further groundwater characterization as a separate investigation Proceed with the Goss Cove FS separate from groundwater investigation	No

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Draft Work Plan and Sampling and Analysis Plan for Lower Subbase Remedial Investigation, NSB-NLON, Groton, Connecticut, March 1997	Fuel Storage Tanks and Tank 54-H, Power Plant Oil Tanks, Building 79 Waste Oil Pit, Building 31, Building 316, Berth 16, Pier 33, Building 174, Classified Materials Incinerator, and Thames River	Lower Subbase, Thames River	Soil Groundwater Surface Water Sediment	None	None	To be determined after the Remedial Investigation is completed	Further characterization. Collect additional soil, groundwater, surface water and sediment samples. Analyze samples for TPH, SVOCs, metals, and natural attenuation and geochemical parameters.	No
Existing Data Summary Report for Lower Subbase Remedial Investigation, Naval Submarine Base, New London, Groton, Connecticut, March 1997	Fuel Storage Tanks and Tank 54-H, Power Plant Oil Tanks, Building 79 Waste Oil Pit, Building 31, Building 316, Berth 16, Pier 33, Building 174, Classified Materials Incinerator, and Thames River	Lower Subbase Thames River	None	None	None	Evaluated existing data for Lower Subbase to determine data gaps that need to be addressed by the Lower Subbase RI. Additional data/zones were evaluated in this report that were not evaluated in the Phase II RI. Additional soil, groundwater, surface water and sediment sampling and analyses are required	Further characterization. Collect additional soil, groundwater, surface water, and sediment samples. Analyze samples for TPH, SVOCs, and metals.	NA
Abbreviated Field Verification Sampling Activities for Site 4 Removal Action, Naval Submarine Base, New London, Groton, Connecticut (Ongoing)	Rubble Fill at Bunker A-86	Rubble Fill at Bunker A-86, Site 3	None	None	None	The presence of soil contamination needs to be determined after the removal action	Collect 14 surface soil samples	NA

TABLE 1-1 (Continued)
SUMMARY OF PREVIOUS AND ONGOING INVESTIGATIONS AND RELATED DOCUMENTATION
NSB-NLON, GROTON, CONNECTICUT

Report	Area Investigated	Associated Phase II RI Site	Media Investigated	Number of Analytical Samples	Analytical parameters	Summary of Findings	Historical Recommendations	Analytical Data Included in the Database
Yearly Groundwater Monitoring Activities for DRMO, Brown & Root Environmental (Ongoing)	DRMO	DRMO, Site 6	Groundwater	None	None	Groundwater impacts need to be evaluated yearly	Collect 10 groundwater samples every quarter	NA

- 1 NA: Not Applicable
2 VC: Volatile organic compounds
BNA: base/neutral acids
Pest/PCB: pesticides and polychlorobiphenols
3 TCLP: Toxicity Characteristic Leaching Procedure
TPH: Total Petroleum Hydrocarbons
4 TSS: Total suspended solids
5 SVOC: Semivolatile organic compounds
6 TCE: Trichloroethylene
7 1,2-DCA: 1,2-dichloroethene
8 TBC: To be considered

TABLE 1-2
BACKGROUND SOIL CONCENTRATIONS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Parameter	Naval Submarine Base Site-Specific Background ⁽²⁾ (mg/kg)	
	(0-2 feet)	(0-4 feet)
Aluminum	17,600	17,600
Arsenic	3.6	3.6
Antimony	2.05 ⁽³⁾	2.05 ⁽³⁾
Barium	39	57.2
Beryllium	0.72	0.72
Boron	3.1 ⁽³⁾	3.1 ⁽³⁾
Cadmium	0.24 ⁽³⁾	0.24 ⁽³⁾
Calcium	314	499
Chromium	19.3	21.5
Cobalt	7	8
Copper	17.9	25.6
Iron	16,800	17,200
Lead	17.5	17.5
Magnesium	2,460	3,650
Manganese	172	188
Mercury	0.055 ⁽³⁾	0.05
Nickel	5.0 ⁽³⁾	5.95 ⁽³⁾
Potassium	669	2,580
Selenium	0.445 ⁽³⁾	0.445 ⁽³⁾
Silver	0.385 ⁽³⁾	0.385 ⁽³⁾
Sodium	16.5 ⁽³⁾	20.5 ⁽³⁾
Thallium	0.105 ⁽³⁾	0.29
Vanadium	33.3	35.1
Zinc	25.6	31.3

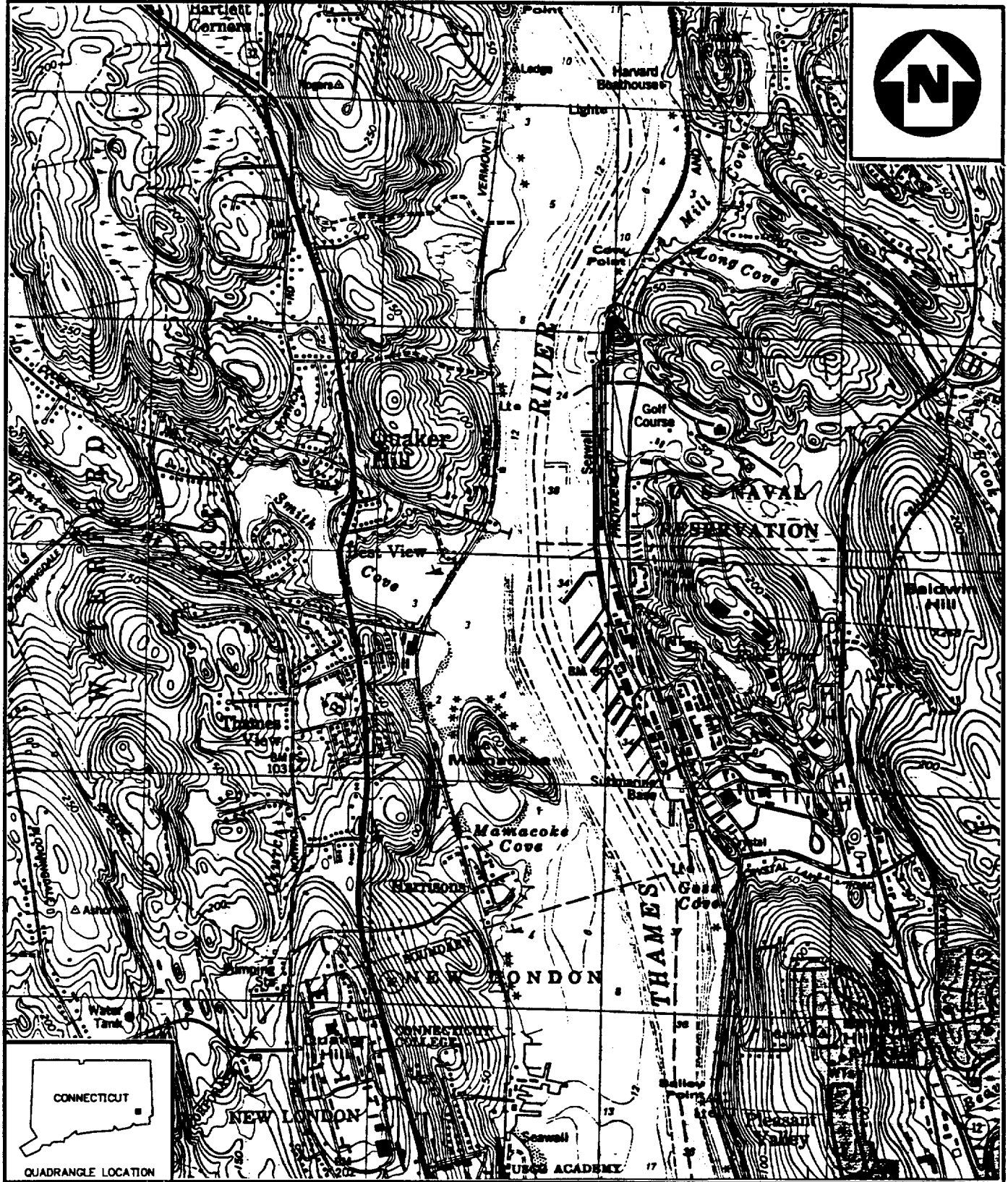
1 All data taken from Atlantic, 1995.

2 The site-specific background value is the highest value detected from among all the background soil samples collected in April 1995.

3 Value based on one-half of the highest detection level from among all the background soil samples collected in April 1995.

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ACAD: D:\DATA\CADD\9594\9594GM21.DWG 02/20/96 DGB



SITE LOCATION MAP
NSB - NLON
GROTON, CONNECTICUT

0 2000 4000
SCALE IN FEET

FIGURE 1-1


Brown & Root Environmental

2.0 STUDY AREA INVESTIGATION

This section summarizes the sampling and analytical procedures used for the Phase II RI conducted at NSB-NLON. Procedures are discussed for geologic, soil and vadose zone (Section 2.3), groundwater (Section 2.4), surface water and sediment (Section 2.5), air investigations (Section 2.6), and ecological (Section 2.7). Summaries of the specific samples collected and the analyses performed for each sample are provided in Sections 5.0 through 17.0 for each of the individual sites. Figures illustrating sample locations at individual sites are also provided in Sections 5.0 through 17.0.

The sampling and analytical procedures used during the Phase I RI, various Focused Feasibility Studies, and other supplemental reports are not discussed in this report. Reference should be made to the appropriate report for that information.

All field work, including all sampling and equipment decontamination, was conducted in accordance with the USEPA- and CTDEP-approved Phase II RI Work Plan prepared by Atlantic Environmental Services, Inc. (Atlantic, May 1993) as modified by Halliburton NUS. All investigation derived wastes (IDW) were collected, containerized in 55-gallon DOT-approved drums, stored temporarily on site, and subsequently transported and disposed of by Laidlaw Environmental.

2.1 SAMPLE NOMENCLATURE

Sample nomenclature for the Phase II RI was based on the system used during the Phase I RI with the exception of the Phase II RI Supplemental Ecological Sampling. Each Phase II RI sample was assigned a sample identification number as outlined in the Field Sampling Plan (Atlantic, May 1993). Each sample identification number consisted of several alpha-numeric characters, providing the site number, a sample description, the sample number, and sample depth information, as appropriate. Sample nomenclature for samples collected during other investigations is not discussed in this report. Reference should be made for the appropriate Work Plan or Field Sampling Plan for the relevant discussion of sample nomenclature. The sample numbering system for the Phase II RI can be summarized as follows:

- **Site Number:** The site at which a sample was collected was identified by the site numbers outlined in the RI Work Plan (as shown on page 1-1). Exceptions include: (1) Area A samples which include an additional letter in the sample identification number indicating the location (i.e., L for Landfill, W for Wetland, D for Downstream Watercourses, and WC for Weapons Center);

(2) Thames River biota samples; (3) pre-Phase I RI Lower Subbase groundwater samples; and (4) Phase II RI Supplemental Ecological Samples from the Area A Downstream Watercourses/OBDA (i.e., S1 for Stream 1, S2 for Stream 2, S3 for Stream 3, S4 for Stream 4, OP for OBDA Pond, UP for Upper Pond, and LP for Lower Pond) and Thames River (i.e., TR for Thames River). It should be noted that the site number for the Area A Weapons Center was Site 2, but has been renamed, at the direction of the Navy, to Site 20. Site numbers used during sampling do not reflect this change.

- **Sample Description:** Samples of various environmental matrices were obtained during the Phase II RI. Matrix-specific alpha characters were used as designations in the sample numbers, as follows: SS - surface soil; TB - test boring (no well installed); MW - monitoring well (soil sample); GW - monitoring well (groundwater sample); SD - sediment; SW - surface water; A - air sample; CMU - control mussel; BVO - bivalve-oyster; MU - mussel; BVC - bivalve-clam. All samples collected during the Phase II RI Supplemental Ecological Sampling rounds in the Area A Downstream Watercourses/OBDA and Thames River have an EC- prefix denoting an ecological sample.
- **Sample Number:** Individual samples were numbered consecutively for each medium at each site and were continued from the previous RI. Monitoring wells for all Area A/Over Bank Disposal Area (OBDA) sites were grouped together and numbered from 1 to 30. The second round of groundwater and air samples were indicated with the suffix -2.

For the supplemental ecological sampling in the Area A Downstream Watercourses/OBDA there were four rounds of sampling and the samples were indicated with a suffix of -01 through -04.

- **Sample Depth:** The soil sampling depth was indicated with a suffix indicating the depth (in feet) below ground surface (e.g., 15MW1S-0103 was a sample obtained from 1 to 3 feet in boring MW1S (shallow) from Site 15).
- **Other Abbreviations:** Other designations used in the sample nomenclature system included the following: S - shallow wells; D - deep wells; -D - duplicate sample.

2.2 GEOLOGIC INVESTIGATIONS

The strike and dip of joints and bedding planes were measured at eleven locations in Area A and the DRMO using a Brunton compass. These measurements supplement the existing information on bedrock geology. The measurements are shown on Drawing 4.

2.3 SOIL AND VADOSE ZONE INVESTIGATIONS

Soil and vadose zone investigative procedures are discussed in this section. These investigations included two soil gas surveys (Area A Downstream Watercourses and the Torpedo Shops), surface soil sampling, completion of soil borings, and subsurface soil sample collection. Investigative procedures are discussed in Section 2.3.1. Analytical procedures are discussed in Section 2.3.2.

2.3.1 Soil and Vadose Zone Investigative Procedures

The various methods used to investigate the soil and vadose zone at the sites investigated at NSB-NLON are discussed in this section. Discussions of soil gas, surface soil, and subsurface soil sampling are provided.

2.3.1.1 Soil Gas Surveys

Soil gas surveys were conducted at two sites (Torpedo Shops and a portion of the Area A Downstream Watercourses/OBDA) at NSB-NLON. The grid surrounding the Torpedo Shops site was laid out around Buildings 325 and 450. Forty-eight locations were attempted to be sampled. Three of the forty-eight sample locations were not sampled due to the presence of water or interference with utilities. The chemicals of concern (COCs) for the Torpedo Shops site were tetrachloroethene, trichloroethene, toluene, benzene, acetone, Freon-113, and m-, p-, and o-xylenes. These COCs were selected based on past detected contaminants at the site, waste disposal history at the site, and the capabilities of the instrumentation used for analyses.

The study area for the Area A Downstream Watercourses/OBDA site was a 150 by 150 foot grid on 25 foot centers. Forty-seven locations were attempted to be sampled. Two of the forty-seven sample locations were not sampled due to repeated auger refusal or the presence of water. The COCs for the Area A Downstream Watercourses site were tetrachloroethene, trichloroethene, and toluene.

Instrumentation, Equipment, and Methodology

The soil gas probe was constructed of a 1/4-inch outside diameter (O.D.) hollow stainless steel tube approximately 5 feet long. The sampling end terminated in a fitting that allowed gas to flow in but prevented the tube from being clogged by soil. The other end consisted of a tee-fitting with an in-line septum fitting perpendicular to the sampling tube (the branch of the tee) and with a section of Teflon tubing attached to the fitting on the run of the tee. The Teflon tubing ran from the sampling tube to a portable air sampling pump.

A slip-hammer was used to pre-drill the holes for the soil gas probe. At the Torpedo Shops site, a hammer-drill was also used to penetrate the blacktop-covered concrete between the two buildings to reach the soil layer. A hole of approximately 4 feet was punched with a slip hammer, the probe was inserted and the top of the hole was sealed with soil. The soil gas was collected from the area around the bottom of the sampling tube, drawn up the tube, and sampled through the septum at the tee. Excess soil gas was exhausted through the peristaltic pump.

The air sampling pump was set on low flow (approximately 1 liter per minute). The soil gas probe was attached to the peristaltic pump and at least 10 to 15 seconds elapsed before sampling. This time was determined empirically by attaching a working standard vial to the bottom of the soil gas probe, and repeatedly measuring the time for the concentration of the standard to maximize in the gas-tight syringe. The gas-tight syringe was inserted into the septum at the top of the soil gas probe and two 500 μ L syringe volumes were withdrawn and discarded. The third volume was very slowly withdrawn, allowing the soil gas to completely fill the syringe, then the syringe plunger was depressed to the 300 μ L mark. A second syringe was filled in a similar fashion in case a re-sample of the location was required. After removal of the sampling rod, ambient air was pulled through the rod to purge the interior of any soil vapors, and the rod was cleaned with deionized water.

The gas chromatographic instrument used to detect the COCs in soil gas was a Photovac 10S50 with the internal heater option. The detector in the instrument was a photoionization detector (PID). The 300 μ L volume of soil gas was injected directly into the GC instrument and a run was triggered. A chromatogram was printed for each run.

Calibration standards were prepared fresh daily and were at a nominal concentration of 1.0 parts per million (ppm). A calibration standard was analyzed at the beginning of sampling, at the end of sampling, and at least once more during each day.

Atlantic standard operating procedures (SOPs) 1052 and 1053 were used as specified in the sampling and analysis plan for the NSB-NLON sites. This was augmented by telephone conversations with the instrument manufacturer, Photovac Corporation, who gave advice on instrument optimization and on the retention times.

All peaks that did not match the approximate retention time of a COC were reported as unknowns. These unknown peaks were grouped together and reported as an equivalent of one of the COCs. For the Torpedo Shops site samples, these results were reported in the field as a benzene concentration-equivalent. For the Area A Downstream Watercourses/OBDA site samples, these results were reported in the field as a toluene concentration-equivalent. The results from the unknown peaks are not summarized in this Phase II RI Report. Additional details regarding soil gas sample analyses are presented in Section 2.3.2.2.

2.3.1.2 Surface Soil Sampling

The surface soil sampling program was designed to identify the presence of chemicals in the upper 6 inches of soil (for the purposes of the risk assessment, soils from 0 to 24 inches were treated as surface soils). A total of eight 0-6 inch deep surface soil samples were collected during Phase II RI. Surface soil sampling protocols specified in Atlantic SOP No. 1020 were followed. Only discrete (grab) samples were collected and were obtained with stainless-steel trowels.

Three surface soil samples and one duplicate, making a total of four soil samples, were collected in July 1995 at the Goss Cove Landfill site as a supplemental characterization effort to the Phase II RI. One sample was collected within the picnic area and two were collected around the submarine exhibits outside of the Nautilus Museum. Areas which receive a high volume of traffic (visitors or workers) were targeted for sampling. For example, samples were taken in proximity to outside submarine exhibits where plaques are located which can be read by the visitors. All soil (soil from depths of 0 to 10 feet) samples were analyzed for Target Compound List volatile organic compounds (TCL VOCs), TCL semivolatile organic compounds (SVOCs), TCL pesticides/PCBs, and Target Analyte List (TAL) metals plus cyanide. A rinsate blank, from the trowel used to collect the soil samples, was sent for analysis to verify decontamination techniques.

2.3.1.3 Soil Borings and Subsurface Soil Sampling

The objectives of the soil boring program were to characterize the physical properties and to classify subsurface soils, to identify areas of potential soil contamination, and to estimate the lateral and vertical nature and extent of soil contamination. A total of 119 soil borings were drilled at NSB-NLON during the

Phase II RI; 47 of these were completed as overburden or overburden/bedrock monitoring wells, 5 were completed as observation wells, 1 was completed as a pumping test well, and 16 were completed as bedrock monitoring wells. The remaining 50 borings were test borings.

The borings were drilled from November 1993 through March 1994 by East Coast-Thomas Environmental of Wallingford, Connecticut. Brown & Root Environmental personnel supervised and inspected drilling activities, logged and field screened soil samples, and collected soil samples for laboratory analyses. Test borings were advanced until auger refusal or to approximately 20 feet below ground surface, or to the desired depth for well installation.

The borings were advanced with 4½-inch inside diameter (I.D.) hollow-stem augers using either a CME-55 or CME-75 truck-mounted drill rig or Diedrich D-50 track-mounted drill rig. Soil samples were collected continuously with 2-foot-long split spoon samplers in accordance with Atlantic SOP No. 1021. Physical characteristics (such as color, density, lithology, and moisture), any visual evidence of contamination (i.e., odor, sheen, or staining), and field screening results for soil samples were recorded on boring logs. All soil (soil from depths of 1 to 10 feet) samples were field screened with an HNu P101 or OVM-B organic vapor analyzer to determine the potential presence of volatile organics. Bedrock core samples from selected borings were collected with either NX or HQ core barrels with diamond core bits. Lithologic descriptions and presence/orientation of fractures in the core samples were recorded in the boring logs. Boring logs are provided in Appendix A.

For the phase II RI a total of 124 soil samples from 83 soil borings were submitted for laboratory analyses. Soil samples were selected for laboratory analyses based on field screening results, visual evidence of contamination, pre-determined depth, or proximity to the groundwater table. Specific analyses and soil sampling intervals are summarized for individual sites in subsequent sections of this report.

2.3.2 Analytical Procedures

This section discusses various analytical procedures used for soil and soil gas samples collected during the Phase II RI. Both fixed-base laboratory services and various field screening techniques were used.

2.3.2.1 Fixed-Base Laboratory

The following fixed-base analytical methods were employed for the soil sampling and analysis program during the NSB-NLON Phase II RI:

- **Target Compound List (TCL)** volatile organic compounds, semivolatile organic compounds, and pesticide and PCB compounds were analyzed in accordance with the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals, cyanide, and an additional analyte [boron]) were analyzed in accordance with the EPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1). Based on the absence of any metal contamination (with the exception of lead) during the Phase I RI soil samples collected at the Lower Subbase were not analyzed for the full Target Analyte List during Phase II. These samples were analyzed only for lead using the aforementioned method in accordance with the approved work plan.
- **Dioxins** were analyzed using the EPA CLP SOW for Dioxin Analysis Multi-Media, Multi-Concentration (Document Number DFLM01.0).
- **Toxicity Characteristic Leaching Procedures (TCLP)** were performed using SW-846 Method 1311, followed by SW-846 Methods 8240, 8270, 8080, 8150, and the 7000 series (volatile organics, semivolatile organics, pesticides, herbicides, and metals, respectively.)
- **Engineering Parameters:** grain size distribution was measured by ASTM D422; moisture content was measured by ASTM D2216; specific gravity was measured by ASTM D854; organic content was measured by ASTM D2974; pH was measured by SW-846 Method 9045; cation exchange capacity (CEC) was measured by SW-846 Method 9081; and total organic carbon (TOC) was analyzed by the Walkley-Black Procedure from Methods of Soil Analysis Part 2 - Chemical and Microbiological Properties.

Not all soil samples at each of the sites were analyzed for the complete set of analytical parameters. A more detailed discussion of the analytical program specific to each site is included in the site-specific sections of this RI report (i.e., Sections 5.0 through 17.0).

Engineering parameter analyses of soil samples were performed by the Halliburton NUS Laboratory in Pittsburgh, Pennsylvania and by Geotesting Express in Concord, Massachusetts. All other soil sample analyses were performed by Southwest Laboratory of Oklahoma in Broken Arrow, Oklahoma.

2.3.2.2 Soil Gas Survey

The soil gas analysis was completed using a Photovac Model 10S50 portable gas chromatograph (GC) with a CPSIL-5 capillary column and photoionization detector (PID) in accordance with Atlantic Procedure No. 1053. Daily GC settings were as follows: oven temperature of 40°C; column flow of 10 mL/min (ultra-high-purity air carrier); gain of 50; injection volume of 300 μ L; and analysis time of 1,000 seconds. The GC was calibrated by injecting qualitative and quantitative standards. These standards are as follows:

- Headspace stock standards diluted in deionized water: acetone, Freon-113, and benzene at 10 ppm each; and benzene, trichloroethene, tetrachloroethene, toluene, and xylenes (o-, m-, and p-) at 20 ppm each.
- Standard of 1 ppm benzene, trichloroethene, tetrachloroethene, toluene, and xylenes (o-, m-, and p-).
- Ambient air quality control sample.

The peaks in the soil gas samples were identified by comparison of retention times to known standards. Standards were run at the beginning, middle, and end of each day, and when and if shifting retention times were observed.

2.3.2.3 Soil Sample Chromatography (GC) Screening

Ten soil samples from the Area A Landfill were field screened for PCBs using GC. All soil samples were analyzed using a field GC and those soil samples yielding the highest PCB concentrations were sent to a fixed-base laboratory (Southwest Laboratory of Oklahoma) for analyses. Sample locations for the Area A Landfill and analytical results are discussed in subsequent sections of this report.

The soil field screening was conducted using a Hewlett-Packard HP5890 Series II portable GC with a dual electron capture detector (ECD). A glass column (1.8-m by 1/4-inch outside diameter) packed with 1.5% SP-2250/1.95% SP-2401 on 100/120 mesh Supelcoport was used. Ultra-high-purity nitrogen was used

as carrier gas and make up for the ECD. Halliburton NUS Corporation Close Support Laboratory SOP No. CSL09 (Pesticide/Polychlorinated Biphenyl Analysis [solid matrix]) was followed.

Daily GC settings were as follows: isothermal oven temperature - 220°C; injection port temperature - 300°C; detector temperature 350°C; flow rate - 30 mL/min (ultra-high-purity nitrogen carrier); injection volume - 2 µL; run time - 20 minutes. The following standards were used:

- Commercially prepared PCB standards were used including Aroclor-1248 at a concentration of 100 µg/mL and Aroclor-1254 at a concentration of 100 µg/mL in iso-octane.
- Commercially prepared standards were diluted in iso-octane at three concentration levels (0.2 mg/L, 1.0 mg/L, 5.0 mg/L).
- A surrogate spiking solution of decachlorobiphenyl and tetrachloro-m-xylene at concentrations of 200 µg/mL each diluted in iso-octane to an on-column concentration of 20 ng; a matrix spiking solution of Aroclor-1254 at a concentration of 200 µg/mL diluted in iso-octane to a on-column concentration of 20 ng.

To prevent carry over, the column was baked for a short period of time and flushed with hexane between analyses. Samples were extracted using 5 grams of sample and 3 grams of anhydrous sodium sulfate in 8 mL of hexane. This solution was mixed thoroughly and a portion of the supernatant was injected to the packed column.

The peaks in the sediment samples were identified via retention time comparison with the standards discussed previously. Mid-point concentration standards were run at the beginning, middle, and end of each day, and whenever an indication of shifting retention times occurred.

Sample results were corrected for moisture content. Therefore, the soil samples underwent a separate procedure to determine percent moisture. Sediment samples were measured for moisture content using Halliburton NUS Corporation Close Support Laboratory SOP No. CSL10 (Percent Moisture Determination for Solid Matrices). Sample weights (wet weight) were recorded and the samples were placed in a drying oven at 103°C for 4 to 6 hours. The samples were then cooled to room temperature and weighed again to determine dry weight. Percent moisture was determined from the wet weight and dry weight measurements.

2.3.2.4 Soil Lead Screening

Soil samples collected at four sites (the Goss Cove Landfill, the DRMO, the Spent Acid Storage and Disposal Area, and the Lower Subbase) were screened for lead content using a portable, lead-specific Scitec X-ray Fluorescence (XRF) analyzer (Model No. FA3C) containing a cadmium-109 source. The results of the XRF screening were used to determine how far to advance test borings. Atlantic Technical SOP No. GTP002 and USEPA Method FM-3 were used. A paint block standard was used for calibration in accordance with the manufacturer's instructions.

2.3.2.5 Soil Headspace Analysis

Soil samples collected at the Area A Weapons Center were screened for total volatile organic vapor. Soil samples were heated in an oven at 80°C for 10 minutes. The headspace of each sample was then analyzed using an Thermo Environmental Instruments organic vapor meter/datalogger (Model 580B). The instrument was calibrated with methylene chloride (53.7 ppm) in nitrogen gas, according to the manufacturer's instructions at the start of sample analysis and at the end of each run day. A total of 39 soil samples were screened and eight of these samples were sent to a fixed-base analytical laboratory (Southwest Laboratory of Oklahoma) for further analyses.

2.4 GROUNDWATER INVESTIGATIONS

The objectives of the Phase II RI groundwater investigation at NSB-NLON were to assess groundwater quality and define the nature and extent of groundwater contamination. The groundwater investigations also provided hydrogeologic information for some sites. Table 2-1 provides a summary of well construction and hydrogeologic information by site for the monitoring wells installed during the Phase II RI and during complementary Area A Landfill and Tank Farm investigations performed subsequent to the Phase II RI field work. Table 2-2 provides similar information for all pre-Phase II RI wells.

2.4.1 Drilling and Well Construction Procedures

A total of 63 permanent groundwater monitoring wells, 5 observation wells, and 1 pumping test well were installed during the Phase II RI. Boring logs and well construction diagrams are included in Appendix A. The locations of these wells are discussed in subsequent site-specific sections of this report. The monitoring wells were installed as either single wells or well clusters. Typical well clusters consisted of a shallow overburden monitoring well and a deep bedrock well. Exceptions consisted of either a shallow overburden well and a deep overburden well (if bedrock was not encountered) or a shallow bedrock well and a deep

bedrock well (if bedrock was encountered at a shallow depth so as to prohibit the installation of an overburden well). Groundwater monitoring intervals were selected to intersect the first significant water-bearing zone in the overburden or bedrock for shallow or deep monitoring wells, respectively.

East Coast-Thomas Environmental of Wallingford, Connecticut provided drilling services, equipment, and materials for the installation of the monitoring wells. The monitoring wells were installed from November 1993 through March 1994. Brown & Root Environmental personnel supervised and inspected drilling activities and logged boring and well construction information.

The Supplemental Area A Landfill investigation and the Tank Farm investigation were performed in September through November 1995. An additional 26 monitoring wells and piezometers 23 overburden and 3 bedrock were installed during the Supplemental Area A Landfill investigation, and 22 overburden monitoring wells were installed during the Tank Farm investigation. Well drilling and construction techniques were the same as with Phase II RI wells.

Overburden Monitoring Wells

A total of 39 overburden monitoring wells, 5 observation wells, and 1 pumping test well were installed during the Phase II RI. Of the 39 overburden monitoring wells, 32 wells were shallow overburden monitoring wells and 7 wells were deep overburden monitoring wells. All overburden wells were installed by advancing hollow-stem augers with an inside diameter (I.D.) of 4½ inches (except for the pumping test well, which was advanced with 8½"-I.D. hollow-stem augers) with either a CME-55 or CME-75 truck-mounted drill rig or Diedrich D-50 track-mounted drill rig. Split-spoon samples of the subsurface soil were collected continuously as described in Section 2.3.1.3.

The overburden wells were constructed of 2-inch-diameter, flush-joint and threaded, Schedule 40 PVC casing and 0.010-inch slotted well screen fitted with a bottom cap, except for the pumping test well which was constructed of 4-inch, Schedule 40 PVC casing and 0.010-inch slotted well screen. Well screens were typically 10 feet in length and were installed to intersect the water table. The top of the well screens were placed at least 1 foot above the static groundwater elevation as determined during drilling to allow for seasonal fluctuations. This procedure could not be followed at all locations as a result of the proximity of the water table to the ground surface. Such wells were screened at or below the water to allow for placement of a proper seal around the well at the ground surface. The annulus between the well screen and the borehole wall was backfilled with washed Ottawa silica sand to a depth of 1 foot above the top of the well screen. The annular space above the sand pack was then backfilled with a 2-foot bentonite seal. The remaining annular space was backfilled with a cement-bentonite (6-to-1 ratio, respectively) mixture using a

tremie pipe. A 4-inch flush-mounted or standing protective steel casing was cemented at the ground surface.

Bedrock Groundwater Monitoring Wells

A total of 16 bedrock groundwater monitoring wells were also installed during the Phase II RI. All bedrock monitoring wells were installed to monitor deep bedrock groundwater (except for well 7MW4S, which was installed by coring and reaming methods as a shallow bedrock well) and were cased through the overburden to the bedrock interface with steel casing to prevent potential downward migration of contaminants. All bedrock monitoring wells (except wells 2WMW5D and 7MW4S) were installed with a Chicago 672 Pneumatic truck-mounted drill rig. Using air rotary drilling techniques, an 8½-inch or 10½-inch air-hammer bit or rollerbit was advanced through the overburden and at least 5 feet into bedrock as verified by inspection of the drill cuttings and core samples. At two wells (6MW6D and 2LMW20D), mud rotary drilling techniques were employed to stabilize the borehole wall. A 6-inch-diameter steel casing was then pressure grouted into the bedrock with a cement-bentonite slurry (except for well 2LMW20D, in which a 8½-inch-diameter steel casing was installed). After the grout had set for at least 24 hours, a 5½-inch air hammer bit was advanced through the casing to the first significant water-bearing zone encountered in bedrock, at least 20 feet below the bedrock surface. A flow rate of approximately 1 gpm or greater was considered an adequate flow. All bedrock monitoring wells were unscreened, except for wells 2WMW5D and 7MW4S. Wells 2WMW5D and 7MW4S were installed by coring and reaming a 6-inch borehole into bedrock and were screened like the shallow overburden monitoring wells, as previously discussed.

Overburden/Bedrock Monitoring Wells

A total of 8 overburden/bedrock monitoring wells were installed during the Phase II RI. These monitoring wells were installed with well screen intervals straddling the overburden and bedrock interface, where a thin layer of overburden did not permit the installation of a shallow overburden monitoring. These wells were installed using either air rotary drilling techniques or a combination of hollow-stem augering and coring and reaming or water rotary drilling techniques. The wells were screened in a manner similar to the shallow overburden monitoring wells. Boring logs and well construction diagrams for the Phase II RI wells are included in Appendix A. Well construction and all wells are provided on Tables 2-1 and 2-2.

All monitoring wells were developed to remove fine materials from the sand pack a minimum of 24 hours after well installation. Shallow monitoring wells were developed with either a peristaltic pump or submersible centrifugal pump. The deep monitoring wells were developed with either a submersible pump or a hand pump. Groundwater temperature, specific conductance, dissolved oxygen, salinity, pH, and turbidity were monitored with a Horiba Water Quality Checker during monitoring well development. Well development was considered complete after these parameters had stabilized (i.e., varied less than 10 percent) and turbidity

was less than 50 nephelometric turbidity units (NTUs) or after seven well volumes had been purged or 4 hours had elapsed, whichever was greater.

2.4.2 Groundwater Sampling Procedures

Brown & Root Environmental personnel collected two rounds of groundwater samples for the Phase II RI from January through July 1994. All of the 63 monitoring wells and the pumping well installed by Halliburton NUS during the Phase II RI were sampled, as well as 60 monitoring wells installed by Atlantic, and 7 monitoring wells on the Lower Subbase installed during previous investigations. Summaries of the groundwater sampling program are provided on a site-specific basis in subsequent sections of this RI report. Groundwater samples were analyzed for various parameters including some or all of the following: VOCs, SVOCs, pesticides, PCBs, inorganics (total and dissolved), TPH, radiological analyses, dioxins, and engineering characteristics.

All groundwater samples and associated quality control samples were collected in accordance with the sampling and analysis program/procedures outlined in the Phase II Remedial Investigation Field Sampling Plan (Atlantic, May 1993) and the Phase II Remedial Investigation Quality Assurance/Quality Control and Data Management Plan (Atlantic, May 1993). All shallow overburden wells were purged with a peristaltic pump outfitted with dedicated Teflon® tubing or a 2-inch submersible centrifugal pump and were typically sampled with a peristaltic pump outfitted with dedicated Teflon® tubing. Dedicated Teflon® bailers were used for VOC sampling. In bedrock wells, a 4-inch Grundfos submersible centrifugal pump or 2-inch submersible centrifugal pump was used for purging, and the samples were collected with Teflon® bailers. All groundwater samples were collected at least 2 weeks after well development had been completed.

Prior to the extraction of any groundwater, the depth to water and the total well depth was measured to the nearest 0.01 foot using an electronic water level indicator. The well volume was then calculated. The water level indicator was properly decontaminated between wells. A minimum of three well volumes was purged prior to groundwater sampling. Groundwater quality parameters (pH, temperature, turbidity, dissolved oxygen, salinity, and specific conductance) were measured at regular intervals during purging. Groundwater samples were collected after these parameters had stabilized to within a 5 percent variance between successive measurements. Sample parameter measurements and static water level and well depth information were recorded on sample log sheets. Stabilized well purging parameters are provided in Appendix D.14. If a well was purged dry, it was sampled within 24 hours after sufficient recharge had occurred.

Wells purged dry during Round 1 and Round 2 sampling are as follows:

Round 1	Round 2
2LMW-7S	8MW-8S
2LMW-13S	8MW-8D
2LMW-13D	2DMW-16D
2DMW-15D	2DMW-23D
2DMW-23D	2LMW-7S
2DMW-26D	2LMW-8D
2DMW-27D	2LMW-9S
2DMW-28D	2LMW-19D
2WMW-3D	2WMW-2D
2WMW-22D	2WMW-3D
7WM-5D	2WMW-6S
8MW-8S	2WMW-15
	NESO 10-2
	15MW-3S

In wells purged with a peristaltic pump, the nonvolatile fractions of the sample were collected through the discharge end of the tubing. Following the collection of the nonvolatile fractions, the peristaltic pump tubing was removed from the well, and the volatile sample was collected with a dedicated Teflon® bailer. When a bailer was used to collect all sample fractions, the volatile sample was collected first to avoid the loss of volatiles through agitation of the groundwater by the bailer. All samples for dissolved metals analysis were field filtered with an in-line 0.45-micron disposable filter. Analytical results for the groundwater samples are summarized in Sections 5.0 through 17.0.

2.4.3 Analytical Procedures

The following analytical methods were employed for the groundwater sampling and analysis program for the NSB-NLON Phase II RI:

- **Target Compound List (TCL)** VOCs, SVOCs, and pesticide and PCB compounds were analyzed in accordance with the EPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals, cyanide, and an additional analyte [boron]) were analyzed in accordance with the EPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1). Groundwater samples were collected and

submitted for total and dissolved metals. The samples submitted for dissolved metals analysis were field filtered.

- **Total Petroleum Hydrocarbons (TPH)** were analyzed in accordance with EPA-600/4-79-020 Method 418.1.
- **Radiological Analyses** were analyzed in accordance with Test Methods for Evaluating Solid Waste: Physical and Chemical Methods, EPA/SW-846, Method 9310.
- **Engineering Parameters**: biochemical oxygen demand (BOD) was analyzed by Method 405.1; chemical oxygen demand (COD) was analyzed by Method 410.2; total organic carbon (TOC) was analyzed by Method 415.1; oil and grease was analyzed via Method 413.1; total suspended solids (TSS) were analyzed by Method 160.2; ammonia was analyzed by Method 350.2; total phosphorus was analyzed via Method 365.1; and hardness was analyzed by Method 130.1. All of the aforementioned methods are from Methods for the Analysis of Water and Wastes (EPA-600/4-79-020).

Groundwater samples were analyzed for various analytical parameters at each of the study areas. A more detailed discussion of the analytical program specific to each study area is included in subsequent site-specific sections of this RI report (specifically Sections 5.0 through 17.0). All groundwater sample analyses were performed by Southwest Laboratory of Oklahoma, in Broken Arrow, Oklahoma.

2.4.4 Water Level Measurements

Monthly water level measurements were conducted at 31 locations for 1 year to provide hydraulic data to construct a basewide groundwater contour map and to assess seasonal variations in the water levels. The 31 locations included 9 single monitoring wells, 18 monitoring well clusters, 1 offsite residential well, and 3 surface water staff gauges. Wells used for monthly water level measurements are summarized in Table 2-3. Wells MW-6, 2WMW1D, OSW-28, and OSW-29 were eliminated from the monthly water level measurements because MW-6 had been destroyed and the others could not be located by Brown & Root Environmental personnel.

Groundwater elevations measured in March 1994, August 1994, and November 1995 were used to construct basewide groundwater contour maps. Water level measurements were obtained with an M-Scope Water Level Indicator and were recorded to the nearest 0.01 inch. Accurate measurements for the flowing artesian well 4GW4D could not be made.

2.4.5 Aquifer Characteristic Investigations

Seven single well hydraulic conductivity tests, one step-drawdown test, and one pump test were conducted at NSB-NLON. Single well hydraulic conductivity tests were conducted at several monitoring wells across NSB-NLON to determine local aquifer characteristics. One step-drawdown and aquifer pumping test were conducted to evaluate the feasibility of pump-and-treat groundwater remediation at the Area A Landfill.

2.4.5.1 Single Well Hydraulic Conductivity Tests (Slug Tests)

Single well hydraulic conductivity tests were performed in accordance with procedures outlined in the Phase II Remedial Investigation Work Plan (Atlantic, May 1993). Rising- and falling-head slug displacement tests were performed at overburden monitoring wells 4MW2S, 6MW3D, 6MW7S, 8MW2S, 8MW2D, 15MW1S, and 15MW3S.

Slug tests were performed using a 5-foot-long, 0.1-foot-diameter solid plastic slug. The slug was lowered and raised with polypropylene rope. A pressure transducer and a Hermit 1000 data logger recorded water level data during the tests.

Prior to each slug test, the static water level was measured with an M-Scope electronic water level indicator. The pressure transducer was placed in the well and allowed to equilibrate. After the water level had returned to its static position, the slug was inserted into the well for the falling-head test. Water levels were measured continuously by the pressure transducer and recorded by a data logger. After the water level recovered to its static position, the water level was remeasured with the water level indicator, and the slug was withdrawn from the well for the rising-head test. Water level measurements were logged and recorded in the same manner as the falling-head test. Recovery plots and calculations are provided in Appendix C. Hydraulic conductivity test results are discussed in Section 4.6.3.2.

2.4.5.2 Step-Drawdown Test

A step-drawdown test was conducted in well 2LPW1S to determine the optimum pumping rate for the aquifer pumping test at the Area A Landfill. Drawdown and discharge measurements recorded during the step-drawdown test were used to empirically determine an optimum yield and to determine the efficiency of the well.

Pressure transducers and a Hermit 2000 data logger recorded water level data in the pumping test well and all the observation wells, except 2LOW4S, during the step-drawdown test. In addition, an In-situ pressure

transducer and a Hermit 1000 data logger were used to record background trend data in monitoring well 2LMW18S. A submersible pump was used for groundwater pumping.

Prior to beginning the step-drawdown test, the pressure transducers and pump were placed in the wells and allowed to equilibrate to the water temperature and pressure. The pump and data logger were started simultaneously to begin the step-drawdown test. The initial pumping rate for pumping well 2LPW1S was 2.0 gallons per minute (gpm). The pumping rate was stepped up to 4.1 gpm 194 minutes into the test. The initial step-drawdown test was ended 244 minutes into the test, after pumping ceased as a result of pump failure. A second step-drawdown test was begun with an initial pumping rate of 5.1 gpm. The pumping rate was stepped up to 8.2 gpm at 100 minutes. The second step-drawdown test was ended at 300 minutes, and the water level recovery was measured for an additional 1,000 minutes. Drawdown and recovery data are provided in Appendix C.

Drawdown and recovery data were plotted against a logarithmic time-scale to identify a sustainable pumping rate for the pumping test. These plots are provided in Appendix C. An optimum pumping rate of 2.0 gpm was chosen for the pumping test.

Groundwater removed from the aquifer during the step-drawdown test was collected in an aboveground contaminant tank and transported to an offsite disposal facility by Clean Harbors Environmental Services.

2.4.5.3 Aquifer Pumping Test

A 72-hour aquifer pumping test was conducted in the overburden materials in the northwest section of the Area A Landfill to further evaluate the feasibility of pump-and-treat groundwater remediation. The aquifer test design included one pumping well (2LPW1S) and five observation wells located at different distances from the pumping well. The observation wells were installed to form two orthogonal radial lines from the pumping well. Observation wells 2LOW1S and 2LOW3S were located 10 feet and 50 feet, respectively, northeast of pumping well 2LPW1S. Observation wells 2LOW2S and 2LOW4S were located 20 feet and 100 feet, respectively, northwest of 2LPW1S. Observation well 2LOW1D was located 10 feet southwest of 2LPW1S. The pumping test well and all observation wells, except 2LOW1D, were screened in the surficial water table aquifer. Observation well 2LOW1D was screened in a confined sandy unit below the clayey silt layer that directly underlies the surficial water table aquifer. Drawdown rates in the observation wells were used to study both time-drawdown and distance-drawdown relationships.

Pressure transducers and a Hermit 2000 data logger were used to record water level data logarithmically in the aquifer pumping test well and all the observation wells with the exception of 2LOW4S. In addition,

an pressure transducer and a Hermit 1000 data logger recorded background trend data linearly in monitoring well 2LMW18S. A submersible pump was used to pump groundwater and produce the drawdown in the aquifer.

Monitoring wells 1MW2S, 2LMW7S, 2LMW7D, 2LMW8S, 2LMW8D, 2LMW9S, 2LMW9D, 2LMW13S, 2LMW13D, 2LMW18S, 2LMW18D, 4MW2S, 4MW3S, 4MW4S, and 4MW4D served as additional observation wells during the aquifer pumping test. Monitoring wells 1MW2S, 2LMW7S, 2LMW8S, 2LMW9S and 2LMW13S provided water level measurements at distances greater than 200 feet from the pumping well. Water level measurements in monitoring wells 2LMW7D, 2LMW9D, 2LMW13D, and 4MW2S, 4MW3S, 4MW4S, and 4MW4D (screened in the bedrock aquifer) were obtained to evaluate the hydraulic interconnection between the overburden aquifer and the bedrock aquifer. Monitoring well 2LMW18S was monitored to assess background variations of hydraulic head in the overburden aquifer.

After a pumping rate of 2.0 gpm was selected based on the results of the step-drawdown test and the water levels within the pump test well cluster had returned to static levels, a 72-hour constant rate aquifer pumping test was conducted. Prior to beginning the aquifer pumping test, static water level measurements were taken in the pumping test well, the observation wells, and the additional monitoring wells. The pump and data logger were started simultaneously to begin the aquifer pumping test. The pumping discharge rate was measured repeatedly at the beginning of the test to set the desired flow rate, then once every half hour for the duration of the test. Necessary adjustments were made to maintain the pumping rate constant at 2.0 gpm. Manual water level measurements in the pumping test well, the observation wells, and the additional monitoring wells were obtained at least once every 3 hours to verify the data logger measurements in the pumping test well and observation wells and to measure drawdown in the additional monitoring wells. Recovering water levels were recorded after the pump was turned off. Aquifer pumping test data, plots, and calculations are provided in Appendix C.

Groundwater removed from the aquifer during the pump test was collected in an aboveground contaminant tanks and transported and disposed at an offsite facility by Clean Harbors Environmental Services.

2.5 SURFACE WATER AND SEDIMENT INVESTIGATIONS

This section describes the surface water and sediment sampling and analysis procedures conducted during the Phase II RI at NSB-NLON.

2.5.1 Sampling Procedures

A total of 52 surface water samples was collected during one sampling round and the samples were analyzed for various constituents. Surface water samples and analyses are identified in sample summary tables included in Sections 5.0 through 17.0. Surface water samples were collected by direct bottle fill in accordance with Atlantic SOP 1022.

A total of 75 sediment samples was collected during one round of sampling and an additional sediment sample was collected in a second round of sampling. Of the 76 total samples collected, 29 samples were field analyzed with a portable GC for pesticides and PCBs, 4 of the 29 samples field screened with the portable GC and the remaining 47 of the 76 samples were sent for laboratory analyses. Sediment samples and analyses are provided in sample summary tables included in Sections 5.0 through 17.0. Sediment samples were collected with stainless-steel trowels in accordance with Atlantic Procedure 1022. All samples were discrete (grab) samples.

2.5.2 Analytical Procedures

Fixed-base laboratory analyses and field screening methods were used for the Phase II RI surface water/sediment investigation. The fixed-base and field methods are discussed in Sections 2.5.2.1 and 2.5.2.2, respectively.

2.5.2.1 Fixed-Base Laboratory

The following fixed-base laboratory analytical methods were employed for the Phase II RI surface water and sediment sampling program at NSB-NLON:

- **Target Compound List (TCL)** VOCs, SVOCs, and pesticide and PCBs were analyzed in accordance with the EPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals, cyanide, and an additional analyte [boron]) were analyzed in accordance with the EPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1). Surface water samples were submitted for analysis of total and dissolved metals. Samples submitted for dissolved metals were field filtered before shipment to the laboratory.

Additional analyses were also completed for surface water samples as follows:

- **Engineering Parameters:** BOD was analyzed by Method 405.1; COD was analyzed by Method 410.2; TOC was analyzed by Method 415.1; oil and grease was analyzed by Method 413.1; TSS were analyzed by Method 160.2; ammonia was analyzed by Method 350.2; total phosphorus was analyzed by Method 365.1; and hardness was analyzed by Method 130.1. All of the aforementioned methods are from Methods for the Analysis of Water and Wastes (EPA-600/4-79-020).

In addition, sediment samples were analyzed for the following parameters:

- **Dioxins** were analyzed in accordance with using the EPA CLP SOW for Dioxin Analysis Multi-Media, Multi-Concentration Document Number DFLM01.0.
- **Toxicity Characteristic Leaching Procedures (TCLP)** was performed in accordance with SW-846 Method 1311, followed by SW-846 Methods 8240, 8270, 8080, 8150, and the 7000 series (volatile organics, semivolatile organics, pesticides, herbicides, and metals, respectively.)
- **Engineering Parameters:** grain size distribution was tested by ASTM D422; moisture content was measured by ASTM D2216; specific gravity was measured by ASTM D854; organic content was measured by ASTM D2974; pH was measured by SW-846 Method 9045; CEC was measured by SW-846 Method 9081; and TOC was analyzed by the Walkley-Black Procedure from Methods of Soil Analysis Part 2 - Chemical and Microbiological Properties.

The surface water and sediment samples collected were analyzed for various analytical parameters at each of the study areas. A more detailed discussion of the analytical program specific to each study area is included in subsequent sections of this RI report.

Engineering parameter analyses of sediment samples were performed by the Halliburton NUS Laboratory in Pittsburgh, Pennsylvania and by Geotesting Express in Concord, Massachusetts. All other surface water and sediment sample analyses were performed by Southwest Laboratory of Oklahoma in Broken Arrow, Oklahoma.

2.5.2.2 Sediment GC Screening

Sediment samples from the Area A Wetland and Downstream Watercourses were field screened for pesticides via gas chromatography. The sediment field screening was conducted using a Hewlett-Packard HP5890 Series II portable GC, a glass column (1.8-m by 1/4-inch outside diameter) packed with 1.5% SP-2250/1.95% SP-2401 on 100/120 mesh Supelcoport, and a dual Electron Capture Detector (ECD). Ultra-high-purity nitrogen was used as carrier gas and make up for the ECD. Halliburton NUS Corporation Close Support Laboratory SOP No. CSL07 (Organochlorine Pesticides Analysis - Solid Matrix) was followed.

Daily GC settings were as follows: isothermal oven temperature - 215°C; injection port temperature - 300°C; detector temperature - 350°C; flow rate - 70 mL/min (ultra-high-purity nitrogen carrier); injection volume - 2 µL; run time - 15 minutes. The following standards were used:

- A commercially prepared pesticide performance evaluation mixture contained varying known concentrations of alpha-BHC, heptachlor, gamma-BHC, endosulfan I, dieldrin, endrin, 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, beta-BHC, aldrin, heptachlor epoxide, 2,4'-DDD, and 2,4'-DDT.
- Commercially prepared standards were diluted in iso-octane at three concentration levels (10 ng/mL, 100 ng/mL, 200 ng/mL); Pesticide Standard Solution A contained alpha-BHC, heptachlor, gamma-BHC, endosulfan I, dieldrin, endrin, 4,4'-DDT, 4,4'-DDD, and methoxychlor; Pesticide Standard Solution B contained beta-BHC, delta-BHC, aldrin, heptachlor epoxide, alpha-chlordane, gamma-chlordane, 4,4'-DDE, endosulfan sulfate, endrin aldehyde, endrin ketone, and endosulfan II.
- A surrogate spiking solution of decachlorobiphenyl and tetrachloro-m-xylene at concentrations of 200 µg/mL each diluted in iso-octane to a on-column concentration of 20 ng; a matrix spiking solution of 4,4'-DDT at a concentration of 200 µg/mL diluted in iso-octane to a on-column concentration of 20 ng.

Remaining aspects of sediment analysis (e.g., column flushing, percent moisture corrections) were equivalent to those used for soil field screening as previously discussed in Section 2.3.2.3.

Thirty-three samples were collected from the Area A Wetland and Downstream Watercourses. Sample locations and analytical results for these sites are summarized in subsequent sections of this RI Report.

2.6 AIR INVESTIGATION

An air monitoring program was conducted to measure indoor air quality in the Nautilus Museum at the Goss Cove Landfill.

2.6.1 Sampling Procedures

During the Phase II RI, a total of 12 air samples were collected during two sampling rounds inside and outside the Nautilus Museum to provide indoor and background air quality information. Samples were collected by drawing ambient air through glass tubes containing Tenax® adsorption media using air sampling pumps at flow rates of approximately 85 to 100 L/min. Samples were collected in accordance with the USEPA T01 method and Atlantic Procedure No. 1256D. All samples were analyzed for volatile organic compounds.

2.6.2 Analytical Procedures

Air samples, collected at Goss Cove Landfill on Tenax tubes, were analyzed for VOCs via Method T01 from Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (EPA 600/4-84-041). This method involves GC adsorption followed by analysis by GC/MS which identifies volatile, nonpolar organic compounds (i.e., aromatic and chlorinated hydrocarbons) having boiling points in the range of 80°C to 200°C.

2.6.3 Supplemental Air Sampling

In evaluating the potential environmental risks at the Nautilus Museum in the Draft Phase II RI Report, several exposure scenarios were evaluated. The exposure scenarios for which the highest risk from air were calculated were the full-time museum employee and the construction worker exposure scenarios. Upon review of the previous two rounds of air sampling, it was felt that the previous sampling technique may not have been the most appropriate for providing information for evaluation of exposure to a worker since the samples were taken over a short time period. A third round of air sampling was therefore performed to more accurately estimate worker exposure. The air sample collection and analysis in the third round of sampling were done in accordance with National Institute for Occupational Safety and Health (NIOSH) methodology, since this methodology is most commonly used to evaluate safe working conditions.

Four air samples were collected plus one field duplicate. Three samples were taken inside the Nautilus Museum and the fourth sample was taken outside the Museum near the outside exhibits. The air sample

outside the building was taken to provide a measure of the ambient air quality. The samples were collected over a 7-8 hour time period, to match a worker-type exposure scenario. Constant volume sampling pumps operating at a nominal flow rate of 100 mL/minute were used to collect the samples. For each sample location, three sample tubes were used; one tube filled with Anasorb sampling media for the 2-butanone sample, and two tubes in series filled with coconut charcoal for the remaining chemicals being analyzed. Two tubes were used in series (the same air drawn through both tubes) in case of breakthrough of chemicals in the first tube.

2.7 ECOLOGICAL INVESTIGATIONS

Ecological investigations were conducted at NSB-NLON to assess ecological quality and define the nature and extent of impacts to ecological receptors. Surface water and sediment samples were collected from the Thames River and Goss Cove in 1993 in support of the Phase II RI. Following a preliminary review of these data, it was determined that elevated concentrations of chemicals were present and additional data were needed to supplement the existing data. In addition, review of ecological data collected during the Phase I RI and Focused Feasibility Study Investigations in the Area A Downstream Watercourses/OBDA site indicated that elevated concentrations of chemicals were also present at this site. Additional data were also necessary to better define the risks to ecological receptors inhabiting this site portion at NSB-NLON. In response, Phase II Supplemental Ecological Investigations were conducted in 1995 in the Thames River, Goss Cove, as well as on the waterbodies within the Area A Downstream Water Courses/OBDA site. Methods used to collect and analyze samples during the Phase II RI and Phase II RI Supplemental Ecological Investigations are summarized in this section. The specific details for the supplemental sampling methods are found in the Work Plan for Thames River Ecological Sampling (HNUS, 1995g).

2.7.1 Sampling Procedures

The sampling methodologies used to collect ecological samples for the Phase II RI and Phase II RI Supplemental Ecological Investigations are summarized in this section.

2.7.1.1 Phase II RI

Surface water and sediment samples were collected in 1993 from the Thames River and Goss Cove as part of the Phase II RI. These samples were collected, in part, to identify potential risks to ecological receptors that are exposed to chemicals transported from NSB-NLON to the river and the cove. In several areas along the western edge of NSB-NLON, chemicals were detected in groundwater and could be transported via groundwater flow into the Thames River and Goss Cove. In addition, chemicals have been detected in

various media within the Area A Downstream Watercourses/OBDA. These chemicals may be transported to the river via two small streams in either a dissolved form or adsorbed to particulates. Methods used to collect surface water and sediment samples from the Thames River and Goss Cove are described below.

Surface Water Sampling

Surface water samples were collected with a 4-liter Kemmerer bottle from eight Thames River stations on December 17 and 18, 1993. Sampling stations were located by line of site to topographic features along the shore. At six of the eight stations, samples were collected from the surface and from approximately 0.5 meter above the bottom of the river bed. However, water was relatively shallow at two nearshore stations and only a surface sample was collected at these locations. Samples were stored in labeled sample containers and shipped overnight to an analytical laboratory. Samples collected from the Thames River and Goss Cove were analyzed for three sets of parameters: 1) chemical analysis for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, cyanide, and boron; 2) engineering parameters (TOC and total suspended solids); and 3) field water quality parameters (salinity, temperature, dissolved oxygen, Secchi disc readings, and turbidity). Vertical profiles were recorded at each sampling station for salinity, temperature, dissolved oxygen, and turbidity. In addition, samples were collected to determine the concentration of dissolved metals. Analytical procedures are discussed in Section 2.7.2.

Sediment and Macroinvertebrate Community Sampling

Sediment and macroinvertebrate community samples were collected from 16 stations on the Thames River between November 9 and 12, 1993. Sediment samples were also collected from 5 locations in Goss Cove during this period. Sampling stations were located by line of site to topographic features along the shore. In addition, Loran coordinates were recorded at each station. Samples were collected with a 0.05 square meter Kynar-coated modified Van Veen grab and transferred to sample bottles with clean stainless steel scoops. Samples were stored in labeled sample containers and shipped overnight to a laboratory for analysis. Sediment samples collected from the Thames River and Goss Cove were analyzed for two sets of parameters: 1) chemical analysis for TCL SVOCs, TCL pesticides/PCBs, TAL metals, cyanide, and boron; and 2) engineering parameters (TOC, grain size, moisture content, specific gravity, organic content, cation exchange capacity, and pH). In addition, one sample collected from the Thames River near Goss Cove was analyzed for TCL VOCs. Analytical procedures are discussed in Section 2.7.2.

Samples to characterize the macroinvertebrate community were collected from each Thames River station. These samples were collected in triplicate with a Van Veen grab sampler. Samples were rinsed through a

500 micron mesh size sieve, preserved with 10 percent formalin, and then sent to a laboratory for taxonomic analysis.

Thames River Caged Mussel Study

A caged mussel study was conducted in the Thames River in the vicinity of NSB-NLON to evaluate bioaccumulation of contaminants from the river. Caged ribbed mussels (*Geukensia demissa*) were deployed in the Thames River in the vicinity of NSB-NLON from November 5, 1993 to December 3, 1993. The ribbed mussels were supplied by the University of New Hampshire's Jackson Estuarine Laboratory. They collected the mussels from Great Bay, New Hampshire. This study employed ribbed mussels instead of blue mussels (*Mytilus edulis*) because they are tolerant of wider ranges of salinity and the mussels were deployed in surface waters with lower salinity. Surface water salinity ranged from 6.7 to 9.5 ppt at the time the mussels were retrieved. Ribbed mussels are similar to blue mussels in their ability to accumulate contaminants such as PCBs (Nelson et al., in press). The deployment methodology used was similar to that developed by the USEPA Environmental Research Laboratory (ERL) in Narragansett, Rhode Island and used at the Naval Construction Battalion Center in Davisville, Rhode Island (Munns et al., 1991). Approximately 30 mussels were deployed per cage, and two cages were deployed per station. One of the deployed replicates was vandalized; therefore, duplicate data are not available from that station. Two sets of thirty undeployed ribbed mussels were sent for chemical analysis as a control set.

Deployment was nearshore in the less saline surface layer (but deep enough for these mussels to remain submerged at low tide). Station locations were selected to be near potential source areas at NSB-NLON where contaminants could reach the river via groundwater flow. An upstream and downstream location was also selected. Mussels were deployed for 28 days to measure bioaccumulation of contaminants. Most organic contaminants reach an equilibrium concentration in bivalve shellfish within thirty days (Nelson, 1994). Although metals can take longer to reach an equilibrium concentration, enough uptake will occur within 28 days to result in a measurable difference between deployed and control mussels if metals are elevated in surface water (Nelson, 1994).

After 28 days, the mussels were retrieved. None of the mussels appeared dead upon retrieval. The mussels were frozen and shucked semi-frozen. The shucked mussels from each cage were pooled to form one sample per cage (two samples per station) and sent frozen on dry ice to the analytical laboratory. The following analyses were performed on these samples: TCL SVOCs, TCL pesticides/PCBs, and TAL metals. Analytical procedures are discussed in Section 2.7.2.

Thames River Native Bivalve Shellfish Collection

Native blue mussels (*Mytilus edulis*), oysters (*Crassostrea virginica*), and hardshell clams (*Mercenaria mercenaria*) were collected with an oyster dredge from the Thames River on November 18, 1993. This sampling was performed under scientific collection permit 400 S/R from the Connecticut Department of Agriculture and Permit No. 231 from the CTDEP. Sample locations were selected to reflect contaminant concentrations in native populations and, incidentally, to provide data for the human health risk assessment. Sufficient individuals were collected to comprise three mussel samples, four oyster samples, and three clam samples. These locations were located either upstream or opposite from NSB-NLON. Sampling locations were limited due to the natural distribution of shellfish in the river. Additional blue mussels were collected December 18, 1993 from pilings at NSB-NLON. Samples were collected by scraping the surface of the pilings with a clam rake. Two of these samples came from the Lower Subbase and a third came from the Nautilus Museum near the Goss Cove landfill. These locations were selected to reflect concentrations in native bivalves in the immediate vicinity of NSB-NLON.

The native bivalve shellfish collected in November were shucked fresh; samples collected in December were frozen and shucked semi-frozen. All tissue samples were sent frozen on dry ice to the analytical laboratory and analyzed. These samples were analyzed for TCL SVOCs, TCL pesticides/PCBs, and TAL metals. Analytical procedures are discussed in Section 2.7.2.

Thames River Blue Crab Collection

Based on a request from the public made at a Technical Review Committee meeting, two separate attempts were made to collect blue crabs (*Callinectes sapidus*) for chemical analysis. Discussions with marine biologists at the University of Connecticut Avery Point campus and the U.S. Coast Guard Academy and with local fishermen indicated that blue crabs are periodically abundant in the Thames River, typically in the months of July and August. However, their presence in numbers in the river is dependent on many factors such as weather and water temperature.

On November 11 and 12, 1993, lobster traps were set in five locations in the river to collect blue crabs. These were set in locations where crabs have been found previously (off from Long Cove and south of Mamacoke Cove; Toldelund, 1975, 1993) and locations near NSB-NLON (off of DRMO and Goss Cove landfill). The traps were placed in the river on November 11, checked during the day, and retrieved on November 12, 1993. No blues crabs were present in these traps.

An additional attempt was made to collect blue crabs between 14:00 and 20:00 hours on July 11, 1994. A line of six crab pots baited with chicken necks and menhaden were set in a variety of locations, including off Long Cove, south of Mamacoke Cove, and areas downstream and across from NSB-NLON. One blue crab was caught during this effort but was not sent to the analytical laboratory because it provided insufficient tissue for analysis.

2.7.1.2 Phase II Supplemental Ecological Investigations

As discussed previously, preliminary examination of samples collected from the Area A Downstream Watercourses/OBDA, Thames River, and Goss Cove in support of the Phase I and Phase II RIs indicated that elevated chemicals were present in these areas and additional data were necessary to determine if ecological receptors were at risk. These additional data were collected during the Phase II RI Supplemental ecological investigations. Data generated as a result of this sampling effort included chemical analyses of surface water (Area A Downstream Watercourses/OBDA) and sediments (Area A Downstream Watercourses/OBDA, Thames River and Goss Cove), a macroinvertebrate community survey (Area A Downstream Watercourses/OBDA), sediment toxicity tests (Area A Downstream Watercourses/OBDA, Thames River and Goss Cove), and analyses to determine levels of AVS/SEM present in sediments (Thames River and Goss Cove).

Thames River and Goss Cove

Sediment samples were collected from 11 locations in the Thames River and Goss Cove to better define the impact of the NSB-NLON on the Thames River ecosystem. Four of these locations had been sampled previously during the Phase II RI. In addition to these four locations, seven new locations were also sampled during the Phase II Supplemental ecological investigations. Sediment collected from one of the stations upstream of NSB-NLON was used as the reference sediment for sediment toxicity tests performed on these samples. The sediment at the remaining 10 locations was considered to be potentially contaminated. A Global Positioning System (GPS) included on the watercraft was used to locate the ten sampling stations in the Thames River.

Sediment samples collected from the Thames River and Goss Cove were analyzed for five different sets of parameters: 1) chemical analysis for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, cyanide, and boron; 2) *Ampileca abdita* and *Leptocherius plumulosus* sediment toxicity tests; 3) SEM/AVS; 4) engineering parameters (TOC and grain size analysis); and 5) field water quality parameters (pH, dissolved oxygen, specific conductivity, temperature, turbidity, and salinity). Analytical procedures are summarized in Section 2.7.2.

All sediment samples were collected using a boat, a modified 0.01m³ teflon-coated Van Veen sampler, stainless-steel trowels, and mixing bowls. A multi-parameter water quality meter was used to record the temperature, pH, DO, specific conductivity, turbidity, and salinity of water near the sediment-water column interface at each location. Once these measurements were completed, a composite sediment sample was collected and discrete samples were collected from the composite sample using stainless-steel trowels, packaged, and shipped to a laboratory to be analyzed for all parameters with two exceptions. The sediment samples to be analyzed for TCL VOCs and AVS/SEM were taken from the first sediment sample collected at a station and not from the composite sample. This technique was necessary to limit volatilization of the VOCs in the sediment sample and aeration of the sample for AVS/SEM analysis. Methods used to obtain samples for these analyses are described below.

Procedures outlined in Draft Analytical Method for Determination of Acid Volatile Sulfide in Sediment (USEPA, 1991a) and Equilibrium Partitioning Approach to Predicting Metal Bioavailability in Sediments and the Derivation of Sediment Quality Criteria for Metals (USEPA, 1994g) provided the basis for AVS/SEM sample collection, analysis and evaluation. The sulfide ion is unstable in the presence of oxygen; therefore, sediment samples collected for AVS/SEM analysis had to be protected from exposure to oxygen during sampling and storage. The sample was obtained directly from the Van Veen sampler to minimize disturbance and aeration of the sediment. The sample was placed in a wide-mouth glass jar with no headspace and capped with a teflon-lined lid. Teflon tape was then wrapped around the lid to seal it and reduce the possibility of air leaks. The samples were immediately cooled to 4°C. According to USEPA (1991a), sediment samples maintained at 4°C have not exhibited a significant loss of AVS for storage periods of up to 2 weeks. The samples were shipped overnight at 4°C to the laboratory for immediate processing to minimize potential exposure to the atmosphere.

Methods outlined in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Estuarine and Marine Amphipods (EPA 600/R-94/025) (USEPA, 1994b) served as the basis for collection and handling methodology for samples used in the sediment toxicity tests. As discussed above, one of the upstream sample locations served as the source of reference sediment used in these tests. A Van Veen sampler was used to collect enough volume of sediment from the reference location so that one toxicity test could be run in conjunction with toxicity tests conducted on sediment samples collected from potentially contaminated locations (i.e., the other ten sampling stations). Additional sediment was collected at the reference station so that if a problem occurred during the testing procedure, the reference sediment could be reevaluated. One to three Van Veen samples were collected from each of the 11 sampling locations and composited to obtain enough sediment to conduct the toxicity tests.

Area A Downstream Watercourses/OBDA

Seven waterbodies in the Area A Downstream Watercourses/OBDA site and three waterbodies in reference areas were sampled as part of the freshwater portion of the Phase II Supplemental ecological investigation. Surface water and sediment samples were taken from the following Area A Downstream Watercourses and reference waterbodies: Upper Pond, Lower Pond, OBDA Pond, the stream that enters the Upper Pond (Stream 4), three separate streams below the ponds and OBDA (i.e., Stream 1, Stream 2, Stream 3), two reference ponds (Niantic Pond and Pequot Woods Pond), and a reference stream (Fishtown Brook). Three sampling stations were located in each water body except for Fishtown Brook which only had two. This resulted in a total of 29 sampling stations.

The reference stream and reference ponds were selected based on their similarity to the ponds and streams in Area A Downstream Watercourses/OBDA. Parameters considered in selecting these reference areas included substrate, morphology, vegetation, current velocity, stream size, water temperature, pH, and dissolved oxygen (DO) levels. Reference locations were located away from known sources of contamination to provide adequate data on background concentrations of contaminants and baseline information on benthic communities. The reference locations were determined by the Navy, USEPA, and BRE.

Niantic Pond was selected to provide reference information for the Lower Pond. The Pequot Woods Pond served as the reference site for Upper Pond and OBDA Pond. The upstream portion of Fishtown Brook (Fishtown Brook 28) has a predominantly sandy sediment and was selected as the reference location for Streams 3 and 4. The downstream portion of Fishtown Brook (Fishtown Brook 29), contains a rich, organic sediment and served as the reference site for Streams 1 and 2.

The samples collected from the ten surface waterbodies (7 waterbodies from the Area A Downstream Watercourses/OBDA and 3 reference locations) were analyzed for several sets of parameters: 1) macroinvertebrate taxonomy (sediment samples only); 2) chemical analysis for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL total and dissolved metals, cyanide, and boron (surface water and sediment samples), and hardness (surface water samples only); 3) *Chironomus tentans* and *Hyalella azteca* sediment toxicity tests (sediment samples only); 4) frog embryo/larval sediment toxicity tests (sediment samples only); 5) engineering parameters (total suspended solids TSS, TOC, and grain size analysis; sediment samples); and 6) field water quality measurements (temperature, pH, DO, specific conductivity, and turbidity; surface water).

Both quantitative and qualitative samples were collected from the ten waterbodies (29 sampling locations) to characterize the macroinvertebrate community. Four rounds of macroinvertebrate samples were collected

from the waterbodies. Samples were taken during four evenly spaced sampling rounds, beginning the second week of March 1995 and continuing through the last week of June 1995. The intent of the multiple sample rounds was to provide an adequate representation of macroinvertebrate species present in each waterbody. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Water (USEPA, 1990) served as the basis for the macroinvertebrate sample collection. In addition, surface water samples were collected during each round for TSS analysis at all 29 sampling locations.

Quantitative sampling was conducted with a petite ponar dredge sampler. The intent of the ponar sampling was to collect representative samples of macroinvertebrates present within the consolidated sediment. Ponar sampling was conducted at each station on all waterbodies. Ponar samples were taken from three sampling stations in each of the ponds and streams located in the Area A Downstream Watercourses/OBDA. The reference stream was sampled at two sampling stations. A total of 29 monthly ponar samples ($3 \text{ stations} \times 9 \text{ waterbodies} + 2 \text{ stations} \times 1 \text{ water body} = 29$) were collected. At each of the ponar sampling stations, one sample was created by compositing three separate samples. For the entire sampling period, a total of 116 samples had been planned ($29 \text{ sample locations} \times 4 \text{ months of sampling} = 116$); however, during the June 1995 round of sampling, some locations (one in the Upper Pond and all three from Stream 2) had dried out and could not be sampled. Consequently, only 112 samples were collected.

During each of the four monthly sampling rounds, one dip-net sample was collected for 10-man minutes from each of the three onsite ponds and from the two reference ponds. A total of 20 dip-net samples was collected ($5 \text{ pond locations} \times 4 \text{ sampling rounds} = 20 \text{ total dip-net samples}$). Dip-net sampling was intended to provide samples of macroinvertebrates present in other types of substrates associated with low energy environments (i.e., leaf material, sticks, twigs, etc.) not captured with the ponar sampler. One dip-net sample station was collected at each pond during each monthly sample round.

Macroinvertebrate sample processing followed ASTM (1985). After collection, samples were washed through a U.S. Standard No. 30 sieve (cobble and larger debris such as rocks and leaves were examined for clinging organisms) and the invertebrates placed in a sample container. Samples were preserved with 70% ethanol. Sample bottles were labeled and sent to the laboratory, where the organisms were identified to genus.

To determine the level of contaminants present in each water body, one round of sediment and surface water samples were collected for laboratory chemical analysis from each of the 29 sampling stations. A total of 29 surface water and 29 sediment samples were collected. Samples were collected in April 1995. All 29 surface water and sediment samples were analyzed for TCL pesticides. Eleven of the surface water and sediment samples (one from each water body except Fishtown Brook which had 2 samples) were analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL total and dissolved metals, cyanide, boron, TOC (sediment

only), grain size (sediment only), TSS (surface water only) and hardness (surface water only), in addition to TCL pesticides.

Surface water samples were collected by direct bottle fill in accordance with Atlantic Procedure 1022. Sample bottles were labeled and shipped to a laboratory for analysis. Field measurements were taken by submerging the probe in the surface water, and the sample for TSS analysis was collected by submerging the sample container. All field measurements and surface water samples for TSS and chemical analysis were collected prior to disturbing the sediments. Samples were collected from downstream to upstream to prevent potential cross-contamination.

A petite ponar dredge was used to collect enough volume of sediment from each location so that chemical analyses and macroinvertebrate toxicity tests could be performed. This required that several ponar samples of sediment be collected and composited. Sediment samples were collected from the same locations used to characterize the macroinvertebrate community in each waterbody. These samples were transferred to sample containers with stainless-steel trowels and shipped to the appropriate laboratory for analysis.

To determine if exposure to toxic materials associated with Area A Downstream Watercourses/OBDA sediments may have adversely impacted freshwater macroinvertebrates, samples of sediment collected from each water body were collected for toxicity tests on *Chironomus tentans* and *Hyaella azteca*. These organisms were selected because they are the best overall indicators of toxic sediments owing to their direct contact with sediment, knowledge of their sensitivity, and proven effectiveness of assays. A total of 11 sediment samples were collected, seven potentially contaminated sediments and four reference sediments. Samples were taken during the second round of the macroinvertebrate sampling in April 1995, when samples for chemical analysis were collected. Mortality and growth served as test endpoints. One laboratory control sediment was included for each test organism to judge the overall acceptability of the tests, resulting in two laboratory control tests with eight replicates per each control.

To evaluate any adverse impacts of contaminants associated with Area A Downstream Watercourses/OBDA sediments on sensitive amphibian life stages samples of sediment were collected for modified FETAX (Frog Embryo Tetratogenesis Assay-*Xenopus*) testing from each water body. These organisms (*Xenopus laevis*) were selected because they are most likely to be representative of indigenous species present in these systems. A total of 11 sediment samples were collected (10 water bodies, two sampling locations on reference stream). Samples were taken during the second (April 1995) round of the macroinvertebrate sampling when samples for chemical analysis are collected. ASTM Method 1439-91 and Bantle et al., 1991 were reviewed prior to the collection of samples and served as the basis for methodologies used to perform these tests, unless otherwise stated.

2.7.2 Analytical Procedures

The analytical procedures employed for the Phase II RI and Phase II RI Supplemental ecological investigations are described in this section.

2.7.2.1 Phase II RI

The following fixed-base laboratory analytical methods were employed for surface water and sediment samples collected in support of the NSB-NLON Phase II RI ecological investigations performed on the Thames River and Goss Cove:

- **Target Compound List (TCL)** VOCs, SVOCs, and pesticide and PCB compounds were analyzed in accordance with the USEPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals, cyanide, and an additional analyte [boron]) were analyzed by the USEPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1). Surface water samples were submitted for analysis of total and dissolved metals. Samples submitted for dissolved metals were field filtered before shipment to the laboratory.

In addition, sediment samples were analyzed for the following parameters:

- **Engineering Parameters:** grain size distribution tested by ASTM D422; moisture content measured by ASTM D2216; specific gravity measured by ASTM D854; organic content measured by ASTM D2974; pH measured by SW-846 Method 9045; CED measured by SW-846 Method 9081; and total organic carbon (TOC) analyzed by the Walkley-Black Procedure from Methods of Soil Analysis Part 2 - Chemical and Microbiological Properties.
- **Quantitative Benthic Survey (Macroinvertebrate Community Analyses)** Organisms were sorted in the laboratory and examined using an illuminated stereomicroscope. Following species-level identification (when possible), organisms were returned to a labelled vial for storage.

The taxonomic data generated from these samples were used to calculate the following macroinvertebrate metrics:

- Number of Taxa
- Total Number of Individuals
- Shannon-Weaver Diversity Index
- Indicator Species
- Bray-Curtis Index
- Expected Number of Taxa
- Statistical Analyses of Benthic Community Parameters

In addition to analyses performed on surface water and sediments, shellfish tissues collected from the Thames River were also analyzed. Following homogenization in the laboratory, the following fixed-base laboratory analytical methods were employed for the analysis of shellfish tissues collected in support of the Phase II RI ecological investigations at NSB-NLON:

- **Target Compound List (TCL)** SVOCs, and pesticide and PCB compounds via the USEPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals) by the USEPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1).

Engineering parameter analyses of sediment samples were performed by the Halliburton NUS Laboratory in Pittsburgh, Pennsylvania. Surface water and sediment sample analyses were performed by Southwest Laboratory of Oklahoma, in Broken Arrow, Oklahoma, with the exception of the macroinvertebrate taxonomy, which was performed by Cove Corporation, in Lusby, Maryland.

2.7.2.2 Phase II Supplemental Ecological Investigations

This section summarizes the analytical procedures employed for surface water and sediment samples collected in support of the NSB-NLON Phase II RI ecological investigations performed on the Thames River, Goss Cove and the Area A Downstream Watercourses/OBDA.

Thames River and Goss Cove

The following fixed-base laboratory analytical methods were employed for sediment samples collected from the Thames River and Goss Cove in support of the Phase II RI Supplemental ecological investigations at NSB-NLON:

- **Target Compound List (TCL)** VOCs, SVOCs, and pesticide and PCB compounds were analyzed in accordance with the USEPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals, cyanide, and an additional analyte [boron]) were analyzed in accordance with the USEPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1).

In addition, sediment samples were analyzed for the following parameters:

- **Engineering Parameters:** grain size distribution was tested by ASTM D422 and TOC was analyzed by the Walkley-Black Procedure from Methods of Soil Analysis Part 2 - Chemical and Microbiological Properties.
- **Acid Volatile Sulfide/Simultaneously Extracted Metals:** Acid Volatile Sulfide (AVS) and Simultaneously Extracted Metals (SEM) were analyzed using procedures outlined in USEPA (1991a), Draft Analytical Method for Determination of Acid Volatile Sulfide in Sediment. SEM analysis had originally been planned for the following parameters, zinc, copper, cadmium, lead, antimony, mercury, chromium, and nickel. However, SEM analysis for antimony were not performed. Based on information contained in USEPA, 1991a, SEM concentrations of zinc, copper, cadmium, lead, mercury, chromium, and nickel were going to be compare to concentrations of AVS. However, more recent USEPA guidance (USEPA, 1994g) now only recommends that SEM concentrations of copper, cadmium, lead, nickel, and zinc be compare to AVS. Therefore, although SEM concentrations of mercury and chromium were measured, these values were not included in subsequent evaluation of these data.

The molar concentrations of SEM bivalent metals were compared to molar concentrations of AVS using the following equation:

$$[AVS] = [AVS] - [SEM]$$

where: [SEM] is the sum of the molar concentrations of cadmium, copper, lead, nickel, and zinc and [AVS] is the molar concentration of acid volatile sulfide.

- **Estuarine Sediment Toxicity Tests:** Estuarine toxicity testing were performed using *Ampelisca abdita* and *Leptocheirus plumulosus* as test organisms. Methods outlined in EPA 600/R-94/025,

Methods for Assessing the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Estuarine and Marine Amphipods (USEPA, 1994b), served as the basis for methodology for the performance of the 10-day sediment toxicity tests. Mortality served as the test endpoint. The results of tests conducted on samples collected adjacent to and downstream of NSB-NLON were compared to the appropriate upstream reference location. In addition, one laboratory control sediment was included for each test organism to judge the overall acceptability of the tests.

The following describes the *A. abdita* test system:

- The test method used was EPA/600/R-94/025 Method 100.2. This was designed as a 10-day Pass/Fail test consisting of a control and one sample treatment. Each treatment replicate consisted of 175 mL of sediment and 800 mL of dilution water. There were eight replicates for each treatment. Twenty test organisms were placed in each replicate. Sediment from the upstream reference location were used in the control treatments. Test organisms were fed Tetrafin. The test was conducted at a temperature of 20°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 1 L borosilicate beakers placed in a constant temperature incubator room (ETT Environmental, 1995).

The following describes the *L. plumulosus* test system:

- The sediment toxicity tests were conducted according to USEPA protocols set forth in EPA/600/R-94/025 Method 100.12. This was designed as a 10-day Pass/Fail test consisting of a control and one sample treatment. Each treatment replicate consisted of 175 mL of sediment and 800 mL of dilution water. There were eight replicates for each treatment. Twenty test organisms were placed in each replicate. Sediment from the upstream reference location were used in the control treatments. Test organisms were fed Tetrafin. The test was conducted at a temperature of 25°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 1 L borosilicate beakers placed in a constant temperature incubator room (ETT Environmental, 1995).

Table 2-4 summarizes the test conditions specified in EPA/600/R-94/025 (USEPA, 1994b).

The survivability of the test organisms in each of the 10 potentially contaminated sediments was statistically compared to the survivability of the test organisms in the Thames River control sediments. Statistical analysis of the data involved tests for normality and homogeneity of variance to determine if parametric analysis was appropriate. Where data was both normal in distribution and homogenous in variance, a "t"

test was used to analyze for differences in survival between the test sediments and the reference station sediments. A Wilcoxon Rank Sum Test was used for non-normal data.

Engineering parameter analyses of sediment samples were performed by Geotesting Express in Concord, Massachusetts. Sediment sample analyses were performed by Southwest Laboratory of Oklahoma, Broken Arrow, Oklahoma, with the exceptions of the estuarine sediment toxicity tests, which were performed by ETT Environmental, Inc., Greenville, South Carolina, and the AVS/SEM analysis, which were performed by Savannah Laboratories and Environmental Services, Inc., Savannah, Georgia (a subcontractor to ETT Environmental, Inc.).

Area A Downstream Watercourses/OBDA

The following fixed-base laboratory analytical methods were employed for sediment samples collected from the Area A Downstream Watercourses/OBDA in support of the Phase II RI Supplemental ecological investigations at NSB-NLON:

- **Target Compound List (TCL)** VOCs, SVOCs, and pesticide and PCB compounds were analyzed in accordance with the EPA CLP SOW for Organic Analysis Multi-Media, Multi-Concentration (Document Number OLM01.8).
- **Target Analyte List (TAL)** inorganics (metals, cyanide, and an additional analyte [boron]) were analyzed in accordance with the EPA CLP SOW for Inorganic Analysis Multi-Media, Multi-Concentration (Document Number ILM02.1). Surface water samples were submitted for analysis of total and dissolved metals. Samples submitted for dissolved metals were field filtered before shipment to the laboratory.

Additional analyses were also completed for surface water and sediment samples as follows:

- **Engineering Parameters (Surface Water)**: total suspended solids (TSS) were analyzed by Method 160.2, and hardness was analyzed by Method 130.1. All of the aforementioned methods are from Methods for the Chemical Analysis of Water and Wastes (EPA-600/4-79-020).
- **Engineering Parameters (Sediment)**: grain size distribution was tested by ASTM D422; and TOC was analyzed by the Walkley-Black Procedure from Methods of Soil Analysis Part 2 - Chemical and Microbiological Properties.

- **Freshwater Sediment Toxicity Tests:** Freshwater sediment toxicity testing were performed using *Hyalella azteca* and *Chironomus tentans* as test organisms. Methods outlined in EPA 600/R-94/024, Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates (USEPA, 1994c), served as the basis for methodology for the performance of the 10-day sediment toxicity tests. Mortality and growth served as test endpoints. The results of tests conducted on samples collected from onsite locations were compared to the appropriate reference location. In addition, one laboratory control sediment was included for each test organism to judge the overall acceptability of the tests.

The following describes the *Hyalella azteca* test system:

- The test method used was EPA/600/R-94/024 Method 100.1 (USEPA, 1994c). This was designed as a 10-day Pass/Fail test consisting of a control and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from Pequot Woods, Niantic Pond and Fishtown Brook were used in the control treatments. Test organisms were fed Yeast-Ceraphyl-trout chow. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room (ETT Environmental, 1995).

The following describes the *Chironomus tentans* test system:

- The sediment toxicity tests were conducted according to USEPA protocols set forth in EPA/600/R-94/024 Method 100.2 (USEPA, 1994c). This was designed as a 10-day Pass/Fail test consisting of a control and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from Pequot Woods, Niantic Pond and Fishtown Brook were used in the control treatments. Test organisms were fed Tetrafin. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room (ETT Environmental, 1995).

Table 2-5 summarizes the test conditions specified in EPA/600/R-94/024 (USEPA, 1994c).

The survivability of the test organisms in each of the 10 potentially contaminated sediments was statistically compared to the survivability of the test organisms exposed to sediments collected from each of the reference locations. Statistical analysis of the data involved tests for normality and homogeneity of variance to determine if parametric analysis was appropriate. Where data were both normal in distribution and homogenous in variance, a "t" test was used to analyze for differences in survival between the test sediments and the reference station sediments. A Wilcoxon Rank Sum Test was used for non-normal data.

- **Frog Embryo Tetragogenesis Assay-Xenopus (FETAX)**: FETAX testing was performed using *Xenopus laevis*. These studies were performed in accordance with the methods cited in ASTM Method 1439-91 with the modifications for whole sediment testing and Bantle et al, 1991. These methods are summarized below (Stover Group, 1995).

Samples were stored at 4°C throughout the study. Tests of the Niantic Pond and Lower Pond samples were initiated on April 10, 1995 and concluded on April 14, 1995. Dissolved oxygen, pH, conductivity, hardness, alkalinity, ammonia-nitrogen, and residual chlorine were measured on two selected batches of dilution water used during the study. Testing was performed in 9 ounce specimen bottles equipped with a glass tube/Teflon mesh insert as the exposure chamber. For the screening tests, 35 g of sediment (wet weight) was placed in the bottom of the specimen jar, the exposure insert added, and filled with 140 mL of FETAX Solution (dilution water). This represented a 1:4 dilution of sediment to dilution water. Blastulae stage embryos were placed directly on the Teflon mesh insert which rested directly over the top of the sediment in the sediment/water interface region. The test consisted of 20 embryos exposed to FETAX Solution (standard negative control), 20 embryos exposed to either 5.5 mg/L or 2,500 mg/L 6-aminonicotinamide [6-AN] (standard positive control), 20 embryos exposed to blasting sand (artificial sediment), and 20 embryos exposed to each sediment sample and respective reference site sediment sample. Fresh solutions and sediments were provided every 24-hours of the 4-day test. Dissolved oxygen and pH were measured prior to renewal and in the waste solutions from each successive day. Due to a dissolved oxygen and pH probe malfunction, readings for the waste solution at 24-hour in the tests with the Niantic Pond and Lower Pond samples were collected on April 12, 1995 and may not be representative. Dissolved oxygen, pH, conductivity, hardness, alkalinity, ammonia-nitrogen, and residual chlorine were measured on two selected batches of FETAX Solution used during the study. A summary of the testing conditions are provided in Table 2-6.

At the conclusion of the test, embryos were preserved in 3% (w/v) formalin (pH 7.0) and morphological characteristics evaluated using a dissecting microscope. Since only screening tests

were performed, determination of LC_{50} and EC_{50} (malformation) were not possible and responses were reported as a percent effect. Coefficient of variation (CV) values were calculated for each test performed. Growth of the surviving larvae was determined using a digitizing software package (Jandell Scientific, Corte Madera, CA) linked to an IBM-compatible computer. Statistical evaluation of differences in response between the reference and treatment sites were performed using Dunnett's test (parametric) or Steele's Many- One Rank test (non-parametric) for the mortality and malformation responses ($P=0.05$ for both), and a grouped t-test for the growth data ($P=0.05$).

- **Macroinvertebrate Taxonomy (Macroinvertebrate Community Analyses)** Organisms were sorted in the laboratory and placed in a 3"- diameter glass petri dish containing 70% isopropanol and examined using an illuminated Meiji Techno stereomicroscope at 15 - 67.5 X magnification. Following genus-level identification (when possible), organisms were returned to a labelled vial containing 70% denatured ethanol for storage (except for voucher specimens). One to three of each genus collected in the survey were placed in the ETT Environmental reference collection as voucher specimens. Some midges and oligochaetes were mounted on glass slides with CMC-10 media and examined with an American Optical 150 Series compound microscope (400X magnification) for identification.

Macroinvertebrate community data from the Area A Downstream Watercourses/OBDA aquatic system were compared with data from reference locations. As detailed in Sediment Classification Compendium (EPA 823-R-92-006)(USEPA, 1992a), the following nine functional and eight structural metrics for lotic systems (streams) were considered:

- Taxa Richness
- Modified Hilsenhoff Biotic Index
- Ratio of scrapers and filtering collectors
- Ratio of Ephemeroptera-Plecoptera-Trichoptera (EPT) and Chironomidae abundances
- Percent contribution of dominant taxa
- Shannon-Weaver Diversity Index
- EPT index
- Community similarity index
- Ratio of shredders to total number of organisms

Engineering parameter analyses of sediment samples were performed by Geotesting Express in Concord, Massachusetts. Surface water and sediment sample analyses were performed by Southwest Laboratory of Oklahoma in Broken Arrow, Oklahoma, with the exceptions of the freshwater macroinvertebrate sediment

toxicity tests and macroinvertebrate taxonomy, which were both performed by ETT Environmental, Inc. in Greenville, SC and the FETAX tests, which were performed by The Stover Group, in Stillwater, Oklahoma.

TABLE 2-1

**SUMMARY OF PHASE II/POST PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT**

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
CBU DRUM STORAGE AREA (PHASE II RI)								
1MW2S	Overburden (Fill)	86.02	88.49	-- ⁽⁴⁾	14.0	4.0-14.0	2	PVC
AREA A LANDFILL (PHASE II RI)								
2LMW19S	Overburden (Fill)/ Bedrock	93.50	95.44	17.5	25.0	15.0-25.0	2	PVC
2LMW19D	Bedrock	93.90	95.74	17.5	120.0	28.0-120.0	6	Steel/Open
2LMW20S	Overburden (Fill)	87.35	87.21	--	26.0	9.0-19.0	2	PVC
2LMW20D	Bedrock	87.55	87.40	69.0	80.0	74.0-80.0	8-3/4	Steel/Open
2LOW1S	Overburden (Fill/Dredge)	86.26	88.40	--	15.0	4.0-14.0	2	PVC
2LOW1D	Overburden (Alluvium)	86.88	89.43	29.3	29.5	23.75-28.75	2	PVC
2LOW2S	Overburden (Fill/Dredge)	86.69	89.09	--	15.0	4.0-14.0	2	PVC
2LOW3S	Overburden (Fill/Dredge)	85.50	87.52	--	14.0	3.0-13.0	2	PVC
2LOW4S	Overburden (Fill/Dredge)	86.83	89.36	--	14.0	4.0-14.0	2	PVC
2LPW1S	Overburden (Fill/Dredge)	86.25	89.07	--	15.0	4.0-14.0	6	PVC
AREA A WETLANDS (PHASE II RI)								
2DMW23D	Bedrock	81.82	83.38	3.0	65.0	7.5-65.0	6	Steel/Open
2WMW5D	Bedrock	74.19	75.96	14.5	29.0	17.5-27.5	2	PVC
2WMW21S	Overburden (Dredge)	74.75	76.47	--	16.0	5.0-15.0	2	PVC
2WMW21D	Bedrock	74.79	76.09	23.0	123.0	28.0-123.0	6	Steel/Open
2WMW22D	Bedrock	121.62	123.69	32.0	182.0	38.0-182.0	6	Steel/Open

TABLE 2-1 (Continued)
SUMMARY OF PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
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AREA A WEAPONS CENTER (PHASE II RI)

2WCMW1S	Overburden (Fill/Dredge)	84.47	83.92	--	18.0	8.0-18.0	2	PVC
2WCMW2S	Overburden (Fill)	86.35	86.16	--	18.0	4.0-14.0	2	PVC
2WCMW3S	Overburden (Fill/Dredge)	83.78	85.95	--	21.0	5.75-15.75	2	PVC

AREA A DOWNSTREAM WATERCOURSES/OBDA (PHASE II RI)

2DMW24S	Overburden (Alluvium)	34.70	36.29	--	14.0	4.0-14.0	2	PVC
2DMW24D	Bedrock	34.54	36.07	17.0	45.0	25.0-45.0	6	Steel/Open
2DMW25S	Overburden (Fill)	33.48	34.98	--	10.5	5.5-10.5	2	PVC
2DMW25D	Bedrock	33.46	35.48	12.0	40.0	18.0-40.0	6	Steel/Open
2DMW26S	Overburden (Alluvium)	28.71	28.71	--	18.0	8.0-18.0	2	PVC
2DMW26D	Overburden (Alluvium))	29.19	29.19	--	50.0	30.0-40.0	2	PVC
2DMW27S	Overburden/Bedrock	28.29	28.17	14.3	17.0	11.5-17.0	2	PVC
2DMW27D	Bedrock	28.32	27.95	14.3	205.0	20.0-205.0	6	Steel/Open
2DMW28S	Overburden (Alluvium)	35.54	35.26	22.0	22.0	17.0-22.0	2	PVC
2DMW28D	Bedrock	35.61	35.40	21.5	136.0	26.0-136.0	6	Steel/Open
2DMW29S	Overburden (Alluvium)	34.98	36.68	--	16.0	6.0-16.0	2	PVC
2DMW30S	Overburden (Alluvium)	31.37	33.11	--	9.5	4.0-9.0	2	PVC

BUNKER A-86 RUBBLE FILL (PHASE II RI)

4MW1S	Bedrock	127.91	129.51	2.5	18.5	8.5-18.5	2	PVC
4MW2S	Overburden (Till)/ Bedrock	96.65	98.79	6.5	15.25	4.5-14.5	2	PVC
4MW3S	Overburden (Till)/ Bedrock	100.55	103.49	4.5	13.5	3.5-13.5	2	PVC

TABLE 2-1 (Continued)
SUMMARY OF PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
4MW4S	Overburden (Till)/ Bedrock	107.80	110.33	4.6	14.5	4.5-14.5	2	PVC
4MW4D	Bedrock	107.29	109.74	8.5	40.0	30.0-40.0	2	PVC

DRMO (PHASE II RI)

6MW2D	Overburden (Alluvium)	6.64	7.85	88.5	88.5	77.0-87.0	2	PVC
6MW3D	Overburden (Alluvium)	4.90	4.78	--	91.0	78.0-88.0	2	PVC
6MW6S	Overburden (Fill)	10.01	12.16	21.5	22.0	6.0-16.0	2	PVC
6MW6D	Bedrock	10.02	12.50	22.0	42.0	28.0-42.0	6	Open
6MW7S	Overburden (Fill)	6.60	6.00	--	16.0	6.0-16.0	2	PVC

TORPEDO SHOPS (PHASE II RI)

7MW2D	Bedrock	43.20	43.02	6.5	45.0	35.0-45.0	2	PVC
7MW3D	Overburden (Alluvium)	44.14	46.67	43.0	43.8	33.8-43.8	2	PVC
7MW4S	Bedrock	47.18	46.84	3.0	14.3	4.0-14.0	2	PVC
7MW5S	Overburden (Alluvium)/ Bedrock	56.92	56.62	12.0	17.0	7.0-17.0	2	PVC
7MW5D	Bedrock	56.82	56.57	12.0	42.0	32.0-42.0	2	PVC
7MW6S	Overburden (Alluvium)	47.04	46.65	32.5	32.5	4.0-14.0	2	PVC
7MW7S	Bedrock	46.95	46.57	4.0	16.0	5.5-15.5	2	PVC
7MW8S	Overburden (Alluvium)	42.28	42.10	--	14.0	3.0-13.0	2	PVC
7MW9S	Overburden (Alluvium)	38.20	37.91	--	15.0	4.0-14.0	2	PVC
7MW10S	Overburden (Alluvium)	40.71	43.42	--	14.0	4.0-14.0	2	PVC
7MW11S	Overburden (Alluvium)	46.70	46.49	--	15.0	4.0-14.0	2	PVC

TABLE 2-1 (Continued)
SUMMARY OF PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
GOSS COVE (PHASE II RI)								
8MW2D	Overburden (Alluvium)	10.17	9.77	--	82.0	54.0-64.0	2	PVC
8MW5S	Overburden (Fill)	11.51	10.94	--	21.0	6.0-16.0	2	PVC
8MW6S	Overburden (Fill)	10.10	9.66	--	14.5	4.0-14.0	2	PVC
8MW6D	Overburden (Alluvium)	9.90	9.62	--	71.0	60.0-70.0	2	PVC
8MW7S	Overburden (Fill)	6.34	5.95	--	20.0	4.0-14.0	2	PVC
8MW8S	Overburden (Alluvium)/ Bedrock	20.01	19.68	12.0	17.0	7.0-17.0	2	PVC
8MW8D	Bedrock	19.83	19.53	12.0	78.0	48.0-78.0	2	PVC
LOWER BASE (PHASE II RI)								
13MW18	Overburden (Fill)	12.65	12.12	--	15.5	5.0-15.0	2	PVC
13MW19	Overburden (Fill)	8.34	8.05	--	18.0	5.0-15.0	2	PVC
13MW20	Overburden (Fill)	10.71	10.45	--	16.0	3.0-13.0	2	PVC
13MW21	Overburden (Fill)	9.03	8.70	--	30.0	5.0-15.0	2	PVC
OVERBANK DISPOSAL AREA, NORTHEAST (PHASE II RI)								
14MW1S	Overburden (Alluvium)	49.22	51.44	--	14.0	4.0-14.0	2	PVC
SPENT ACID STORAGE AND DISPOSAL AREA (PHASE II RI)								
15MW1S	Overburden (Alluvium)	28.35	28.08	--	15.0	5.0-15.0	2	PVC
15MW1D	Overburden (Alluvium)	28.25	28.05	--	46.0	36.0-46.0	2	PVC

TABLE 2-1 (Continued)
SUMMARY OF PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
15MW2S	Overburden (Alluvium)	29.28	28.90	--	17.0	5.0-15.0	2	PVC
15MW3S	Overburden (Alluvium)	26.44	26.26	--	15.0	5.0-15.0	2	PVC
15MW4S	Overburden (Alluvium)	26.37	26.24	--	43.0	4.0-14.0	2	PVC

AREA A LANDFILL (POST-PHASE II RI)

2LPZ1F	Overburden (Fill)	78.80	79.30	--	8	5-8	2	PVC
2LPZ2F	Overburden (Alluvium)	90.00	91.10	--	6	3-6	2	PVC
2LMW28F	Overburden (Alluvium)	85.30	87.43	--	12	4.6-9.6	2	PVC
2LMW28DS	Overburden (Dredge)	85.20	87.41	--	21	14.8-19.8	2	PVC
2LMW29F	Overburden (Fill)	88.70	90.30	--	15.5	3.5-8.5	2	PVC
2LMW29DS	Overburden (Alluvium)	88.80	90.96	--	16	11-16	2	PVC
2LMW30F	Overburden (Fill)	81.20	80.79	--	12.3	7.3-12.3	2	PVC
2LMW30DS	Overburden (Dredge)	80.70	80.32	--	23	17.9-22.9	2	PVC
2LMW31F	Overburden (Fill)	85.90	86.64	--	6	3-6	2	PVC
2LMW31DS	Overburden (Dredge)	86.00	88.16	--	14	9-12	2	PVC
2LMW32PZ	Overburden (Alluvium)	80.60	82.11	--	16	9.6-14.6	2	PVC
2LMW32F	Overburden (Fill)	80.80	82.95	--	24	17-22	2	PVC
2LMW32DS	Overburden (Dredge)	80.80	82.69	--	24	19-24	2	PVC
2LMW32B	Bedrock	80.60	82.74	63.5	86.5	76.2-86.2	2	PVC
2LMW33F	Overburden (Fill)	81.00	82.86	--	9.9	4.9-9.9	2	PVC
2LMW33DS	Overburden (Dredge)	79.40	82.87	--	18	13-18	2	PVC
2LMW34DS	Overburden (Dredge)	77.50	77.05	--	22	17-22	2	PVC
2LMW35B	Bedrock	198.20	199.14	7	103	11-103	6	Steel/Open
2LMW36B	Bedrock	212.30	213.04	1.8	103	2-103	6	Steel/Open

TABLE 2-1 (Continued)
SUMMARY OF PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
2LPZ1DS	Overburden	70.78	74.23	--	7.56	4.56-7.56	2	Steel
2LPZ2DS	Overburden	73.14	76.74	--	7.57	4.57-7.57	2	Steel
2LPZ3DS	Overburden	71.61	73.98	--	7.45	4.45-7.45	2	Steel
2LPZ4DS	Overburden	71.64	74.29	--	7.66	4.66-7.66	2	Steel
2LPZ5DS	Overburden	71.64	75.08	--	6.77	3.77-6.77	2	Steel
2LPZ6DS	Overburden	71.63	74.83	--	6.94	3.94-6.94	2	Steel
2LPZ7DS	Overburden	73.43	78.78	--	8.10	5.10-8.10	2	Steel

TANK FARM (POST-PHASE II RI)

HNUS-1	Overburden (Fill)	NA ⁽⁵⁾	NA	--	14	4-14	2	PVC
HNUS-2	Overburden (Fill)	NA	18.31	--	14	4-14	2	PVC
HNUS-4	Overburden (Fill)	NA	18.85	--	14	4-14	2	PVC
HNUS-5	Overburden (Fill)	NA	18.96	--	14	4-14	2	PVC
HNUS-6	Overburden (Fill)	NA	19.70	--	15	5-15	2	PVC
HNUS-7	Overburden (Fill)	NA	20.23	--	15	5-15	2	PVC
HNUS-8	Overburden (Fill)	NA	20.30	--	15	5-15	2	PVC
HNUS-9	Overburden (Fill)	NA	19.65	--	14	4-14	2	PVC
HNUS-10	Overburden (Fill)	NA	20.86	--	15	5-15	2	PVC
HNUS-11	Overburden (Fill)	NA	NA	--	15	5-15	2	PVC
HNUS-12	Overburden (Fill)	NA	24.08	--	15	5-15	2	PVC
HNUS-13	Overburden (Fill)	NA	23.32	--	15	5-15	2	PVC
HNUS-14	Overburden (Fill)	NA	20.57	--	15	5-15	2	PVC
HNUS-15	Overburden (Fill)	NA	20.74	--	15	5-15	2	PVC
HNUS-16	Overburden (Fill)	NA	18.70	--	15	5-15	2	PVC

TABLE 2-1 (Continued)
SUMMARY OF PHASE II RI MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology (Stratigraphic Unit) ⁽¹⁾	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
HNUS-17	Overburden (Fill)	NA	19.69	--	14	4-14	2	PVC
HNUS-18	Overburden (Fill)	NA	19.84	--	15	5-15	2	PVC
HNUS-20	Overburden (Fill)	NA	NA	--	15	5-15	2	PVC
HNUS-21	Overburden (Fill)	NA	20.12	--	15	5-15	2	PVC
HNUS-22	Overburden (Fill)	NA	NA	--	20	10-20	2	PVC
HNUS-23	Overburden (Fill)	NA	18.03	--	17	7-17	2	PVC
HNUS-24	Overburden (Fill)	NA	NA	--	5	5-12	2	PVC

- 1 Alluvium = Quarternary river/stream deposits
Dredge = Dredge spoil (clayey silt)
Fill = Silty sand or sand and/or gravel (artificial)
Terrace = Quarternary terrace deposits (sand and/or gravel)
Till = Quarternary nonstratified drift deposits (varying amounts of sand, silt, gravel, and/or clay)
- 2 msl - above mean sea level
- 3 bgs - below ground surface.
- 4 -- Indicates that bedrock was not encountered in the boring for this monitoring well.
- 5 NA - Information not available.

TABLE 2-2

**SUMMARY OF EXISTING MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT**

Well ID	Screened Lithology ⁽¹⁾ (Stratigraphic Unit)	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
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CBU DRUM STORAGE AREA

No monitoring wells were installed at this site during pre-Phase II RI investigations.

AREA A DOWNSTREAM/OBDA

2DMW10D	Bedrock	52.80	54.52	3.5	26.09	10.0-26.09	6	Steel/Open
2DMW11S	Overburden (Alluvium)	45.40	46.85	-- ⁽⁴⁾	17.5	2.45-12.45	2	PVC
2DMW11D	Bedrock	51.50	53.20	17.0	25.55	19.5-25.55	6	Steel/Open
2DMW15D	Bedrock	42.20	44.09	4.0	19.51	10.0-19.51	6	Steel/Open
2DMW16S	Overburden (Alluvium)	35.60	37.85	--	13.5	1.69-11.69	2	PVC
2DMW16D	Bedrock	35.90	37.69	12.5	59.91	18.0-59.91	6	Steel/Open
3MW12S	Overburden (Alluvium)	41.00	43.51	--	13.0	2.34-12.34	2	PVC
3MW12D	Bedrock	41.10	42.20	15.0	26.1	20.0-26.1	6	Steel/Open

AREA A LANDFILL

2LMW7S	Overburden (Fill/Dredge)	82.80	84.37	30.2	50.0	11.65-21.65	2	PVC
2LMW7D	Bedrock	83.10	85.16	28.5	43.59	33.5-43.59	6	Steel/Open
2LMW8S	Overburden (Fill/Alluvium)	86.40	87.45	--	20.5	5.5-15.5	2	PVC
2LMW8D	Bedrock	87.1	89.33	41.5	124.4	46.5-124.4	6	Steel/Open
2LMW9S	Overburden (Fill/Dredge)	85.3	86.96	--	42.5	8.24-18.24	2	PVC
2LMW9D	Bedrock	85.4	87.11	42.0	59.74	47.0-59.74	6	Steel/Open
2LMW13S	Overburden (Fill)	86.9	88.53	16.0	36.0	6.46-16.46	2	PVC
2LMW13D	Bedrock	86.8	88.20	19.5	60.03	24.5-60.03	6	Steel/Open

TABLE 2-2 (Continued)
SUMMARY OF EXISTING MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology ⁽¹⁾ (Stratigraphic Unit)	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
2LMW14D	Bedrock	91.9	93.90	13.5	27.0	18.5-27.0	6	Steel/Open
2LMW17S	Overburden (Fill/Dredge)	82.48	82.12	--	18.5	7.75-17.75	2	PVC
2LMW17D	Bedrock	82.62	82.37	18.0	39.0	22.1-39.0	6	Steel/Open
2LMW18S	Overburden (Fill)	77.94	77.60	--	33.5	5.74-15.74	2	PVC
2LMW18D	Bedrock	77.67	77.34	36.0	49.03	41.0-49.03	6	Steel/Open

AREA A WEAPONS CENTER

No monitoring wells were installed at this site during pre-Phase II RI investigations.

AREA A WETLANDS

2WMW1D	Bedrock	128.05	127.58	3	95.55	8-95.55	6	Steel/Open
2WMW2D	Bedrock	110.45	110.22	4.00	49.93	9.0-49.93	6	Steel/Open
2WMW3S	Overburden (Fill/Dredge)	82.80	84.37	--	41.5	7.79-22.79	2	PVC
2WMW3D	Bedrock	81.68	81.36	73.0	127.1	78.0-127.1	6	Steel/Open
2WMW4D	Bedrock	93.07	92.69	9.0	119.4	13.0-119.4	6	Steel/Open
2WMW5S	Overburden (Dredge)	73.50	76.48	--	13.2	2.54-12.54	2	PVC
2WMW6S	Overburden (Fill/Dredge/Alluvium)	83.40	84.67	--	9.5	4.28-9.28	2	PVC
2WMW6D	Bedrock	83.20	84.87	10.5	46.0	15.5-46.0	6	Steel/Open

BUNKER A-86 RUBBLE FILL

No monitoring wells were installed at this site during pre-Phase II RI investigations.

DRMO

6MW1S	Overburden (Fill)	7.00	8.63	--	14.2	4.0-14.0	2	PVC
6MW2S	Overburden (Fill/Dredge)	5.40	7.30	--	20.0	3.2-13.2	2	PVC

TABLE 2-2 (Continued)
SUMMARY OF EXISTING MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology ⁽¹⁾ (Stratigraphic Unit)	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
6MW3S	Overburden (Fill/Dredge)	4.30	6.10	--	20.0	3.8-13.8	2	PVC
6MW4S	Overburden (Fill)	5.18	4.90	--	20.0	2.8-12.8	2	PVC
6MW5S	Overburden (Alluvium)	14.05	13.88	25.5	46.5	7.2-17.2	2	PVC
6MW5D	Bedrock	14.23	13.93	25.0	34.8	30.0-34.8	6	Steel/Open
6MW8S	Overburden (Fill)	5.65	5.50	--	10.0	1.0-6.0	2	PVC

TORPEDO SHOPS

7MW1D	Bedrock	54.67	54.08	6.5	25.2	14.2-25.2	6	Steel/Open
7MW2S	Overburden (Alluvium)	48.6	50.41	--	11.5	4.0-11.0	2	PVC
7MW3S	Overburden (Fill/Alluvium)	45.98	45.71	--	20.0	6.9-16.9	2	PVC

GOSS COVE

8MW1	Overburden (Fill)	10.48	10.15	--	20.0	6.4-16.4	2	PVC
8MW2S	Overburden (Fill)	9.91	9.43	--	20.0	5.9-15.9	2	PVC
8MW3	Overburden (Fill)	9.25	8.96	--	20.0	5.8-15.8	2	PVC
8MW4	Overburden (Fill)	9.62	9.34	--	20.0	5.4-14.4	2	PVC

LOWER SUBASE

13MW1	Overburden (Alluvium)	13.73	13.36	--	20.0	7.49-17.49	2	PVC
13MW2	Overburden (Alluvium)	13.23	12.8	--	20.0	7.67-17.67	2	PVC
13MW3	Overburden (Alluvium)	13.15	12.89	--	20.0	7.36-17.36	2	PVC
13MW4	Overburden (Fill)	10.29	10.14	--	20.0	4.95-14.95	2	PVC
13MW5	Overburden (Fill)	11.72	11.13	--	20.0	7.92-17.12	2	PVC
13MW6	Overburden (Fill)	21.84	21.47	--	30.0	17.82-27.82	2	PVC
13MW7	Overburden (Fill)	8.19	7.85	--	20.0	4.34-14.34	2	PVC
13MW8	Overburden (Fill)	7.80	7.34	--	27.0	3.71-13.71	2	PVC

TABLE 2-2 (Continued)
SUMMARY OF EXISTING MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology ⁽¹⁾ (Stratigraphic Unit)	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
13MW9	Overburden (Fill)	7.57	6.91	--	20.0	4.78-14.78	2	PVC
13MW10	Overburden (Alluvium)	8.73	8.44	--	20.0	5.0-15.0	2	PVC
13MW11	Overburden (Alluvium)	8.23	7.83	--	20.0	4.0-14.0	2	PVC
13MW12	Overburden (Fill)	9.55	9.21	--	20.0	5.3-15.3	2	PVC
13MW13	Overburden (Fill/Dredge)	8.94	8.50	--	20.0	4.6-14.6	2	PVC
13MW14	Overburden (Fill)	8.48	7.98	--	20.0	4.8-14.8	2	PVC
13MW15	Overburden (Fill)	7.70	7.25	--	20.0	2.6-12.6	2	PVC
13MW16	Overburden (Fill/Dredge)	7.64	7.30	--	20.0	3.5-13.5	2	PVC
13MW17	Overburden (Alluvium)	7.71	7.47	--	35.0	3.5-13.5	2	PVC
19MW2	Overburden (Alluvium)	7.28	6.98	--	5.75	1.78-5.78	2	PVC
19MW3	Overburden (Alluvium)	7.18	6.89	--	6.6	2.3-6.3	2	PVC
19MW4	Overburden (Alluvium)	7.33	7.09	--	5.75	1.7-5.7	2	PVC
20MW2	Overburden (Alluvium)	7.96	7.74	--	16.0	2.5-12.5	2	PVC
20MW3	Overburden (Alluvium)	6.83	6.66	--	16.0	2.5-12.5	2	PVC
20MW4	Overburden (Alluvium)	8.29	8.09	--	16.0	4.0-14.0	2	PVC
20MW5	Overburden (Alluvium)	6.79	6.46	--	16.0	3.5-13.5	2	PVC
20MW6	Overburden (Alluvium)	10.19	10.02	--	16.0	4.0-14.0	2	PVC
20MW7	Overburden (Alluvium)	6.18	5.96	--	14.0	2.5-12.5	2	PVC
NESO 4	Overburden (Alluvium)	8.51	8.22	NA ⁽⁵⁾	NA	2.9-7.9	2	PVC
NESO 6	Overburden (Alluvium)	8.89	8.67	NA	NA	1.4-6.4	2	PVC
NESO 10	Overburden (Alluvium)	8.42	8.10	NA	NA	4.3-9.3	2	PVC
NESO 11	Overburden (Alluvium)	8.89	8.78	NA	NA	3.6-8.6	2	PVC
WE 1	Overburden (Alluvium)	9.62	9.42	NA	15.3	5.3-15.3	2	PVC

TABLE 2-2 (Continued)
SUMMARY OF EXISTING MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology ⁽¹⁾ (Stratigraphic Unit)	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
WE 4	Overburden (Fill/Alluvium)	8.71	8.61	NA	13.4	3.4-13.4	2	PVC
WE 5	Overburden (Alluvium)	8.37	8.25	NA	14.0	4.0-14.0	2	PVC

OVERBANK DISPOSAL AREA, NORTHEAST

No monitoring wells were installed at this site during pre-Phase II RI investigations.

SPENT ACID STORAGE AND DISPOSAL AREA

No monitoring wells were installed at this site during pre-Phase II RI investigations.

TANK FARM

ERM-1	Overburden (Fill)	NA	20.10	--	16	3.54-13.04	2	PVC
ERM-2	Overburden (Fill)	NA	19.64	--	16	3.71-13.21	2	PVC
ERM-4	Overburden (Fill)	22.25	21.90	--	16.0	3.53-13.03	2	PVC
ERM-5	Overburden (Fill)	NA	21.67	--	16	3.52-13.02	2	PVC
ERM-11	Overburden (Fill)	NA	20.51	--	16	3.39-12.89	2	PVC
ERM-13	Overburden (Fill)	NA	23.13	--	15.5	5.5-15.05	2	PVC
ERM-14	Overburden (Fill)	NA	22.82	--	15.0	5.5-14.78	2	PVC
ERM-15	Overburden (Fill)	NA	20.24	--	12.0	2.25-11.75	2	PVC
ERM-17	Overburden (Fill)	NA	19.76	--	12.4	2.72-12.22	2	PVC
ERM-19	Overburden (Fill)	NA	19.64	--	12.4	2.81-12.31	2	PVC
MW-6	Overburden (Alluvium)	NA	21.89	--	12.0	3-10	2	PVC
MW-7	Overburden (Alluvium)	NA	19.12	--	12.0	3-10	2	PVC
MW-11	Overburden (Alluvium)	NA	25.23	--	12.0	3-10	2	PVC
OBG-7	Overburden (Terrace)	25.37	25.15	NA	NA	NA	2	PVC
OT-MW01	Overburden (Fill/Alluvium)	22.04	25.11	--	22	17-22	2	PVC

TABLE 2-2 (Continued)
SUMMARY OF EXISTING MONITORING WELL INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Well ID	Screened Lithology ⁽¹⁾ (Stratigraphic Unit)	Ground Elevation (feet msl) ⁽²⁾	Reference Elevation (feet msl)	Depth to Bedrock (feet bgs) ⁽³⁾	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Well Construction Type
OT-MW02	Overburden (Fill/Alluvium)	22.86	25.71	--	22	17-22	2	PVC
OT-MW03	Overburden (Fill/Alluvium)	22.25	25.35	--	22	17-22	2	PVC
OT-MW04	Overburden (Fill/Alluvium)	22.74	25.97	--	22	17-22	2	PVC

OFF-SITE RESIDENTIAL

OSW2	Bedrock	66.97	67.62	NA	165	NA	NA	NA
OSW3	Bedrock	44.96	47.08	NA	80	NA	NA	NA
OSW5	Overburden	54.09	55.80	--	4	NA	NA	NA
OSW8	Bedrock	81.47	82.43	NA	90	NA	NA	NA
OSW8A	Overburden	76.67	78.63	NA	~10	NA	NA	NA
OSW10	Overburden	11.21	12.96	--	NA	NA	4.5 ft	NA
OSW11	Spring	23.15	23.15	--	--	NA	NA	NA
OSW12	Bedrock	141.13	139.63	NA	50	NA	NA	NA
OSW14	Bedrock	NA	53.52	NA	300	NA	NA	NA
OSW23	Overburden	143.11	140.11	NA	NA	NA	NA	NA

- 1 Alluvium = Quarternary river/stream deposits
Dredge = Dredge spoil (clayey silt)
Fill = Silty sand or sand and/or gravel (artificial)
Terrace = Quarternary terrace deposits (sand and/or gravel)
Till = Quarternary nonstratified drift deposits (varying amounts of sand, silt, gravel, and/or clay)
- 2 msl - above mean sea level
- 3 bgs - below ground surface
- 4 -- Indicates that bedrock was not encountered in the boring for this monitoring well.
- 5 NA - Information not available.

TABLE 2-3

**SUMMARY OF MONITORING WELLS AND STAFF GAUGES
MONTHLY WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT**

Well Identification	Location
15MW3S, OBG-7, ERM-4, 8MW8S/D, 8MW8S/D	South end of base
13MW1, 13MW19, 13MW8	Lower Subase
6MW5S/D, 6MW3S/D	DRMO
OSW12, 2LMW19S/D, 2W21S/D, 2WMW2D, WMW3S/D, 2LMW20S/20D, 2WMW5S/5D, 2LMW18S/18D	Near hospital gate and along Route 12
2LMW7S/7D, 3MW12S/12D, 7MW3S/3D, 2DMW16S/16D, 2DMW24S/24D, 2DMW25S/25D, 2DMW27S/27D, 19MW4, 2WMW22D, 2DMW23D, SG-4, SG-5, SG-6	Area A Downstream, Torpedo Shops, and North Lake

TABLE 2-4

PHASE II RI - SUPPLEMENTAL ECOLOGICAL SAMPLING
IN THE THAMES RIVER
TEST CONDITIONS FOR ESTUARINE SEDIMENT TOXICITY TESTS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Test Parameter/Condition	Test Organism	
	<i>Ampelisca abdita</i>	<i>Leptocheirus plumulosus</i>
Test Type	10 Day Static	10 Day Static
Temperature	20° ± 1°C	25° ± 1°C
Light Quality	500-1000 lux; 24 hr. light/ 0 hr. dark	500-1000 lux; 24 hr. light/ 0 hr. dark
Test Chamber Size	1 L borosilicate glass beaker	1 L borosilicate glass beaker
Test Solution Volume	175 mL sediment; 800 mL overlying water	175 mL sediment; 800 mL overlying water
# of Organisms per Replicate	20	20
# of Replicates per Test	8	8
Age of the Test Organisms	3-5 mm	2-4 mm
Aeration	Throughout test	Throughout test
Feeding	None	None
Dilution Water	Reconstituted	Reconstituted
Test Solution Renewal	None	None
Test Concentrations	Control and 100% Sediment	Control and 100% Sediment
Water Quality Parameters	temperature, pH salinity, DO and ammonia	temperature, pH, salinity, DO, and ammonia
Test Endpoints	10 day survival	10 day survival

¹ USEPA, 1994b

TABLE 2-5

PHASE II RI - SUPPLEMENTAL ECOLOGICAL SAMPLING
IN AREA A DOWNSTREAM WATERCOURSES
SEDIMENT TOXICITY TEST CONDITIONS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Test Parameter/Condition	Test Organism	
	<u>Hyalella azteca</u>	<u>Chironomus tentans</u>
Test type	Whole sediment toxicity test with renewal of overlying water	Whole sediment toxicity test with renewal of overlying water
Temperature	23 ± 1°C	23 ± 1°C
Light Quality	Wide-spectrum fluorescent lights	Wide-spectrum fluorescent lights
Illuminance	About 500 to 1000 lux	About 500 to 1000 lux
Photoperiod	16 hours light, 8 hours dark	16 hours light, 8 hours dark
Test chamber	300-ml high form lipless beaker	300 mL high form lipless beaker
Sediment volume	100 mL	100 mL
Overlying water volume	175 mL	175 mL
Renewal of overlying water	2 volume additions/d; continuous or intermittent (e.g., one volume addition every 12 h)	2 volume additions/d; continuous or intermittent (e.g., one volume addition every 12 h)
Age of Organisms	7- to 14-d old at the start of the test	Third instar larvae (all organisms must be third instar or younger with at least 50% of the organisms at third instar)
Number of organisms/chamber	10	10
Number of replicate chambers/treatment	Eight replicates for routine testing	Eight replicates for routine testing
Feeding	YCT food, fed 1.5 mL daily to each test chamber	Tetrafin goldfish food, fed daily to each test chamber (1.5 mL contains 4.0 mg of dry solids)
Aeration	None, unless dissolved oxygen in overlying water drops below 40% of saturation	None, unless dissolved oxygen in overlying water drops below 40% of saturation
Overlying water	Culture water, well water, surface water, site water, or reconstituted water	Culture water, well water, surface water, site water, or reconstituted water
Test chamber cleaning	If screens become clogged during a test, gently brush the outside of the screen	If screens become clogged during a test, gently brush the outside of the screen
Overlying water quality	Hardness, alkalinity, conductivity, pH, and ammonia at the beginning and end of a test; temperature and dissolved oxygen daily	Hardness, alkalinity, conductivity, pH, and ammonia at the beginning and end of a test; temperature and dissolved oxygen daily
Test duration	10 d	10 d

TABLE 2-5 (Continued)
PHASE II RI - SUPPLEMENTAL ECOLOGICAL SAMPLING
IN AREA A DOWNSTREAM WATERCOURSES
SEDIMENT TOXICITY TEST CONDITIONS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Test Parameter/Condition	Test Organism	
	<u>Hyalella azteca</u>	<u>Chironomus tentans</u>
Endpoints	Survival (growth optional)	Survival and growth (dry weight)
Test acceptability	Minimum mean control survival of 80% and performance-based criteria specifications outlined in other table	Minimum mean control survival of 70% and performance-based criteria outlined in other table

¹ USEPA 1994c

TABLE 2-6

PHASE II RI - SUPPLEMENTAL ECOLOGICAL SAMPLING
IN AREA A DOWNSTREAM WATERCOURSES
FROG EMBRYO/LARVAL TOXICITY TEST CONDITIONS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Test Parameter	Frog Embryo Teratogenesis Assay (FETAX) Test Conditions
Test type	Static Renewal
Temperature	23° ± 1°C
Light Quality	Ambient laboratory illumination
Light intensity	10-20 $\mu\text{E}/\text{m}^2/\text{s}$ (50-100 ft-c) (ambient laboratory levels)
Photoperiod	12 hours light, 12 hours dark
Test chamber size	9 ounces
Test solution volume	35 g of sediment, 140 mL Fetax Solution
Renewal of test solutions	Daily
Age of test organisms	Small cell blastulae (Stage 8-10)
Number of larvae per chamber	10
Number of replicate test chambers per concentration	Negative Control = 4 Positive Control = 2 Treatments = 8
Number of larvae per concentration	Negative Control = 100 Positive Control = 50 Treatments = 160
Test vessel randomization	Randomization chart #3 was utilized for this test
Feeding Regime	None
Cleaning	Siphoned daily, immediately before solution renewal
Aeration	None
Dilution water	FETAX Solution was prepared using E-PURE ^R deionized water and reagent grade chemicals
Number of concentrations	Controls plus treatments
Test duration	Survival, malformation, growth (length)
Test acceptability	Mortality and malformation rates in control $\leq 10\%$ and $\leq 10\%$, respectively

¹ ASTM Method 1439-91 and Bantle et al., 1991

3.0 GENERAL DATA EVALUATION PROCEDURES

This section provides a summary of general analytical data evaluation and risk assessment procedures that are common to each of the thirteen sites studied during the Phase II RI for NSB-NLON. Section 3.1 provides a general discussion of various data quality issues (i.e., data quality objectives, data validation). Section 3.2 discusses general aspects of contaminant fate and transport analysis. Human health and ecological risk assessment procedures are discussed in Sections 3.3 and 3.4, respectively.

Database

A database was created for use in preparing this Phase II RI report. Selected analytical data from previous investigations were evaluated and included in this database used for nature and extent discussions as well as human health and ecological risk assessment. The previous investigations selected for inclusion in the database are provided in Table 1-1.

The screening process for determining whether data were acceptable for inclusion in the database included:

- Data age: appropriateness for present day nature and extent of contamination and risk assessment,
- Data quality: data defensibility,
- Data location: outside versus inside Phase II RI Site boundary, and
- Frequency of analyses: number of samples per location.

It should also be noted that analytical data pertaining to selected previous investigations at the Lower Subbase were not included in the core database. The rationale for this decision was based on the fact that an expanded RI is planned for the Pier 33 and Berth 16 in the near future. It is intended to cover a broader area of the Lower Subbase and will encompass the Pier 33 and Berth 16 area. At that time, an evaluation of available data will be made using the screening criteria above, and the data will be selected and added into the existing database.

3.1 DATA QUALITY

Various quality control measures were implemented during field sampling and laboratory analysis to ensure that the resultant data were suitable for their intended use. A brief summary of these measures is provided in this section.

3.1.1 Data Quality Objectives

A detailed discussion of the Data Quality Objectives (DQOs) for the NSB-NLON Phase II RI is provided in the Atlantic QA/QC Plan (Atlantic Environmental Services, Inc., May 1993) and the associated Halliburton NUS addendum (HNUS, October 1993a). DQOs for all field and laboratory analyses, which includes requirements for precision, accuracy, and completeness, are summarized in this section.

3.1.1.1 Precision

Precision characterizes the amount of variability and bias inherent in a data set. This parameter also describes the reproducibility of measurements of the same parameters for samples under similar conditions. Precision is expressed as a Relative Percent Difference (RPD), which is defined as the relation of the range relative to the mean. RPDs, which are typically expressed as percents, are used to evaluate both field and laboratory duplicate precision and are calculated as follows:

$$RPD = \frac{V1 - V2}{2(V1 + V2)} \times 100$$

where: RPD = relative percent difference
V1,V2 = two results obtained by analyzing duplicate samples

The precision objectives for CLP parameters are specified in the associated analytical protocols and were presented in Table 7.1 of the Atlantic QA/QC Plan. For non-CLP data, the precision objectives of ± 50 percent for solid matrices and ± 30 percent for aqueous matrices were employed for the project.

Field duplicates monitor the consistency with which environmental samples were obtained and analyzed. Laboratory duplicates measure the reproducibility of laboratory generated results. RPDs were calculated for each set of field and laboratory duplicates generated for the investigation. Failures in meeting the precision objectives resulted in the qualification (as per data validation protocols) of the associated analytical

data. The qualification of Phase II RI analytical data is discussed in Section 3.1.3 of this report, as well as the implications of the data qualifications.

3.1.1.2 Accuracy

The degree of accuracy of a measurement, which is expressed as a percent recovery, is based on a comparison of the measured value with an accepted reference or true value. Accuracy measurements are determined by the analysis of "spiked" samples (i.e., blank, surrogate, or matrix spikes). These analyses measure the accuracy of laboratory operations as affected by the sample matrix. Percent recovery is calculated using the following equation:

$$\%R = \frac{S_s - S_o}{S} \times 100$$

where: %R = percent recovery
 S_s = result of spiked sample
 S_o = result of non-spiked sample
 S = concentration of spiked amount

In general, the accuracy objective for the NSB-NLON project is defined as 75 to 125 percent (percent recovery). Method-specific objectives expressed on an analyte-specific basis were presented in Table 7.1 of the Atlantic QA/QC Plan. Failures in meeting the accuracy objectives resulted in the qualification (as per data validation protocols) of the associated analytical data. A discussion of the qualification of Phase II RI analytical data and the implications of the data qualifications is provided in Section 3.1.3.

3.1.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from the field and laboratory analysis in relation to the total amount of data collected. Completeness is typically expressed as a percentage and is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where: %C = percent completeness
V = number of results determined to be valid
T = total number of results

Under ideal conditions, the completeness objective would be 100 percent. However, samples can be rendered unusable during shipping or preparation (e.g., bottles broken or extracts accidentally destroyed) or analysis (e.g., loss of instrument sensitivity, strong matrix effects). The completeness objective for this project is ≥ 90 percent, as stated in the Atlantic QA/QC Plan. The calculated percent completeness for all validated data presented in this RI Report is 97.9% (i.e., 2,775 analytical results out of a total of 131,002 data points were qualified as unusable), indicating that the data completeness objective for the project was achieved.

Table 3-1 contains a list of those sample results which were determined to be invalid and unusable via data validation. Section 3.1.3 contains a summary of the data validation results and describes, in general, the rationale behind the rejection of these analytical results.

3.1.2 Field Quality Control Samples

The following field quality control (QC) samples were collected and analyzed in accordance with DQO Level C, D, and E requirements, as specified in the Atlantic QA/QC Plan (Atlantic Environmental Services, Inc., May 1993) for the RI Phase II sampling effort:

- Field duplicates were obtained at a frequency of one per every ten samples (10%) per matrix. Field duplicates for soil samples are two separate samples collected from the same source. Aqueous sample duplicates are collected simultaneously. Duplicates assess the overall precision of the sampling and analysis program.
- Trip blanks of analyte-free water were generated by the laboratory, taken to the sampling site, and returned to the laboratory with the samples to be analyzed for volatile organic compounds. Analytical results for trip blanks are used to determine the level of contamination associated with the transportation of samples. One trip blank was collected per each cooler and analyzed for volatile organics.
- Rinsate blanks were obtained by pouring analyte-free water over sample collection equipment (e.g., bailers, etc) after decontamination to assess the effectiveness of field decontamination

procedures. Samples were obtained at a frequency of 1 per day per media per analysis. However, only samples generated every other day were subjected to chemical analysis.

- Field blanks consisted of source water samples used in steam cleaning and/or decontamination and are used to determine the level of contamination associated with the source water. Field blanks were obtained at a frequency of 1 per event per decontamination water source.

Documentation for the actual collection of the aforementioned field QC samples is provided in Appendix B.2, Chain of Custodies (COCs), for all Phase II RI analytical data.

3.1.3 Data Validation

All Phase II RI analytical data were subjected to data validation. Data validation is an objective systematic process in which analytical data are reviewed to ascertain the validity of the reported results and to identify for the data user the possible limitations of these results. This section summarizes the various aspects of the data validation process.

3.1.3.1 General Data Validation Procedures

Validation of data generated for samples collected at NSB-NLON during the Phase II RI was completed in accordance with the procedures for Level D and Level C data validation as outlined in Navy guidance (Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, NEESA 20.2-047B). Level D data validation was performed for all samples analyzed via the USEPA's Contract Laboratory Program (CLP) methods, as well as for some samples analyzed via SW-846 methods that are similar to the CLP methods (e.g., the 8000 series methods). Such data were validated in accordance with the USEPA's CLP Functional Guidelines for Organic and Inorganic Data Review, as amended for use in USEPA Region I. Level C validation was completed for various engineering and chemical/physical parameters, radiological data, and air samples in accordance with the functional guidelines to the greatest extent practicable, in view of method-specific quality assurance/quality control requirements and criteria outlined in the NEESA guidance document.

The validation process included consideration of the following: data completeness, holding time compliance, mass calibrations, field QC and laboratory generated blanks, internal standards, surrogate spikes, blank spikes, matrix spikes, field duplicate precision, chemical interferences, quantitation, detection limits, and system performance.

Evaluation of laboratory and field QC blank analyses aided in the elimination of false positive results which were identified as laboratory artifacts. The overall determination of data utility or reliability was based upon laboratory compliance with specified methods and adherence to quality control requirements. The noncompliance observed during the validation process resulted in qualification of analytical data. The qualifiers alert the data user to imprecise or estimated results, and, in the worst case, unreliable and unusable data.

The net results of the validation process were summarized in sample delivery group-specific technical reports consisting of a memorandum, a section of qualified analytical results, Region I validation worksheets, and a supporting documentation section which provided the rationale for changes and/or qualification of the data. These memoranda provided a detailed explanation of the results of the data validation review. As a result of the magnitude of the Phase II RI, in excess of 100 data validation memoranda were generated. All data validation documentation is currently retained on file by B&R Environmental.

3.1.3.2 Data Validation Qualifiers

As mentioned previously, the qualification of analytical data during the validation process (i.e., application of U, J, UJ, UR, and R qualifiers) was conducted as required by the USEPA Functional Guidelines. The attachment of the data qualifiers to analytical results signifies the occurrence of quality control noncompliance which have been noted during the course of data validation. The various data qualifiers are defined, as follows:

- U - Indicates that the chemical was not detected at the numerical detection limit (quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.
- UJ - Indicates that the chemical was not detected. However, the detection limit (quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.
- J - Indicates that the chemical was detected. however, the associated numerical result is not a precise representation of the amount which is actually present in the sample. The laboratory reported quantity is considered to be an estimate.

- **UR** - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliance, and extremely low quality control recoveries).
- **R** - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

The preceding data qualifiers may be categorized as indicative of major problems and minor problems. Major problems are defined as issues that result in the rejection of data, qualified with UR and R data validation qualifiers. These data are considered invalid and are not used for risk assessment and decision making. Minor problems are defined as issues resulting in the estimation of data, qualified with the U, J, and UJ data validation qualifiers. Estimated analytical results are considered to be suitable for risk assessment and decision making purposes.

3.1.3.3 Summary of Data Validation Results

A brief summary of the data validation results for the Phase II RI sampling effort is provided below. All validated analytical results for NSB-NLON are presented in Appendix D (Analytical Database).

Organics Analyses

Acetone, chloroform, methylene chloride, toluene, benzoic acid, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and phenol were identified as laboratory and/or field QC blank contaminants on a frequent basis. Other chemicals sporadically detected in the laboratory and field QC blanks include 2-butanone, carbon disulfide, chloromethane, 1,3-dichlorobenzene, 1,1,1-dichloroethene, 2-hexanone, tetrachloroethene, 1,1,1-trichloroethane, benzyl alcohol, butylbenzylphthalate, diethylphthalate, and heptachlor. Detection limits for these compounds in the affected environmental samples were elevated during the data validation process as positive results are considered to be attributable to blank contamination.

In general, analytical results for organic compounds were qualified as estimated, J or UJ, for observed noncompliance with matrix spike analyses, laboratory control standards, surrogate spike analyses, internal standards, calibrations, holding times, and field duplicate precision. Positive results reported at

concentrations less than the Contract Required Quantitation Limit (CRQL) were also qualified as estimated. Because of missed holding times, organic results for the following environmental samples were estimated, J or UJ:

- 2DGW16D-2
- 2DGW25D-2
- 2WCSD4
- 2WCSD5
- 2WCSD7
- 2WCSD11
- 4SD2
- NESO6-2
- 6MW2D-0406
- PIPECHASE

Holding time exceedances were not considered to be gross noncompliance, therefore, the rejection of sample data was not warranted. Field duplicate/replicate imprecision was noted for various organic parameters in the following sample pairs:

- 2DGW26D / 2DGW26D-D (bis(2-ethylhexyl)phthalate)
- 2DGW29-S-2 / 2DGW29-S-D-2 (vinyl chloride, 1,2-dichloroethene)
- 2WCTB2-0002 / 2WCTB2-0002-D (4,4'-DDE)
- 2WCMW3S-1618 / 2WCMW3S-1618-D (carbon disulfide, some semivolatiles)
- 4SS6 / 4SS6-D (some volatiles, semivolatiles, pesticides, PCBs)
- 7GW3S-2 / 7GW3S-D-2 (1,1,1-trichloroethane)
- 8GW4S / 8GW4S-D (some volatiles, semivolatiles)
- 8GW5S / 8GW5S-D (tetrachloroethane, some semivolatiles)
- 8AS1 / 8AS1-D (acetone, 2-butanone)
- 8TB5-1416 / 8TB5-1416-D (some volatiles, semivolatiles, pesticides)
- 8TB14-1214 / 8TB14-1214-D (some volatiles, semivolatiles, pesticides, PCBs)
- CMU1 / CMU1-R (some volatiles)
- CMU2 / CMU2-R (some volatiles, semivolatiles)
- CMU4 / CMU4-R (some volatiles, pesticides, PCBs)
- CMU5 / CMU5-R (some volatiles, semivolatiles)
- MU-C / MU-C-D (some volatiles, pesticides/PCBs)
- T3SD1 / T3SD1-D (4,4'-DDT)
- T5SD4 / T5SD4-D (some semivolatiles)
- EC-SDTR06-02 / DUP-07 (2-butanone)

The associated analytical results in the field duplicate pair samples only were regarded as estimated and were qualified as such.

Severe calibration problems (i.e., relative response factors < 0.05) were observed in eight organic sample-delivery groups. These gross noncompliance resulted in the rejected of nondetected results for acetone, hexachlorocyclopentadiene, 2-hexanone, 4,6-dinitro-2-methylphenol, 2,4-dinitrophenol, 4-nitrophenol, and N-nitroso-di-n-propylamine in the affected samples. Additionally, nondetected results for endrin and 4,4',-4,4' DDT in some mussel samples (CMU2, CMU3, CMU4-R, MU-C, and MU-C-D) were considered to be unreliable and qualified as rejected, R, as a result of severe breakdown criteria exceedances. Organic results for some ecological samples were also rejected because of poor column performance, extremely low matrix spike recoveries, and extremely low percent solids. A summary of the rejected analytical results for the Phase II RI samples is provided in Table 3-1.

Inorganic Analyses

Several inorganic chemicals were detected as contaminants in the laboratory and/or field QC blanks at varying concentrations. The detection limits of those results that were found to be attributable to blank contamination introduced during laboratory analysis or field sampling were raised during the validation process.

Inorganic sample results were typically qualified as estimated based on problems noted with instrument calibrations, matrix spikes, post digestion spikes (graphite furnace data only), analysis of Contract Required Detection Limit (CRDL) standards, laboratory and field duplicate precision, serial dilution analyses (ICP only), laboratory control standards, chemical interferences (ICP only), and poor instrument performance (i.e., baseline drifting). Because of uncertainty near the Instrument Detection Limit (IDL), sample results less than two times the IDL were also considered to be estimates. Noncompliant field duplicate RPDs were noted for some inorganic parameters in the following sample pairs and the associated sample results were qualified J or UJ for field duplicate imprecision:

- 2DGW15D-2 / 2DGW15D-D-2 (iron for dissolved matrix)
- 2DGW29S-2 / 2DGW29S-D-2 (lead for total matrix)
- 4SW2 / 4SW2-D (boron for dissolved matrix, iron for total matrix)
- 4SS6 / 4SS6-D (aluminum)
- 7GW9S / 7GW9S-D (iron for total matrix)
- 8SD4 / 8SD4-D (arsenic, chromium, lead, zinc)

- 8TB14-1214 / 8TB14-1214-D (chromium, iron, lead, manganese, zinc)
- 8TB5-1416 / 8TB5-1416-D (barium, cobalt, mercury, zinc)
- 13TB3A-2.5-4.5 / 13TB3A-2.5-4.5 (TAL and TCLP lead)
- T5SD4 / T5SD4-D (calcium, mercury)
- BV03 / BV03-D (copper, sodium, zinc)
- EC-SDS09-02 / DUP-05SD (lead)
- EC-SWS09-02 / DUP-05W (iron for total matrix)
- EC-SWNP23-2 / DUP-04 (boron for total matrix)

Inappropriate sample preservation techniques (i.e., measured pH values > 2) were observed for the following samples. All inorganic results for these samples were qualified as estimated, according to USEPA Region protocols.

- 13GW18-2 (total matrix)
- 2WCGW3S-2 (total matrix)
- 2WCGW1S-2 (total matrix)
- 2WCGW1S-2 (dissolved matrix)
- 2WCGW3S-2 (dissolved matrix)
- 2WGW21S-2 (total and dissolved matrices)

Gross matrix spike recovery noncompliance (i.e., percent recoveries < 30%) resulted in the rejection of some sample results for antimony, arsenic, lead, mercury, selenium, silver, and thallium. Extreme chemical interferences (from high analyte concentrations of calcium, iron, magnesium, and/or sodium) were reported for various chemicals analyzed by ICP. Analytical results for antimony, barium, boron, cadmium, chromium, copper, lead, sodium, and vanadium in the affected samples were considered to be invalid and were qualified as rejected, R. All unreliable and unusable results for Phase II RI analyses are presented in Table 3-1.

Miscellaneous Parameters

The total phosphorus result for sample 7GW3D-2; BOD results for samples 4GW3S-2, 8GW7S-2, 8SW6, and 8SW5; and the acid volatile sulfide result for EC-SD3-02 were qualified as estimated because of marginal holding time exceedances. Some TPH results were considered to be estimates because of low laboratory control standard recoveries. Because of observed field duplicate imprecision, analytical results in the following sample pairs were qualified as estimated:

- 13TB3A-2.5-4.5 / 13TB3A-2.5-4.5-D (TPH)
- EC-SWS209-02 / DUP-05 (hardness for dissolved)
- EC-SWNP23-02 / DUP-04 (hardness for total and dissolved matrices)

In general, analytical data for miscellaneous parameters (such as TPH, BOD, TOC, etc.) were accepted without qualification.

All validated analytical results for NSB-NLON are presented in Appendix D (Analytical Data Base). This data base is inclusive of all results (i.e., nondetects and positive results) and is used to define the nature and extent of contamination, assess contaminant fate and transport, and to complete the baseline human health and ecological risk assessments.

3.2 CHEMICAL FATE AND TRANSPORT ANALYSIS

Various aspects of contaminant fate and transport at NSB-NLON are discussed in this section. Properties that affect chemical migration are presented in Section 3.2.1. Section 3.2.2 presents a brief discussion of chemical persistence. Section 3.2.3 presents an overview of chemical fate and transport. Specific aspects of chemical transport at each site are discussed in Sections 5.0 through 17.0.

3.2.1 Chemical and Physical Properties

Various chemical and physical properties of all detected site compounds are presented and discussed in this section. These parameters may be used to estimate the environmental behavior of site chemicals. Physical and chemical properties of the organic chemicals found at NSB-NLON are presented in Table 3-2.

Literature values of the water solubility, octanol/water partition coefficient, organic carbon partition coefficient, vapor pressure, Henry's Law constant, bioconcentration factor, and specific gravity are presented, when available. Calculated values, which were obtained using approximation methods, are presented when literature values are not available. A discussion of the environmental significance of each of these parameters follows.

3.2.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a

contaminant will have a tendency to float or sink in water if it is present as a pure compound or at very high concentrations. Contaminants with a specific gravity greater than 1 will tend to sink, whereas contaminants with a specific gravity less than 1 will tend to float. This parameter becomes important in discussions regarding the potential presence of free product or nonaqueous-phase liquids.

Of the commonly detected chemicals at these sites, the ketones and some monocyclic aromatics have specific gravities less than 1. The halogenated aliphatics, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phthalate esters, and pesticides have specific gravities greater than 1.

3.2.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces, such as surface soil/air and surface water/air. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils. Vapor pressures for ketones, monocyclic aromatics, halogenated aliphatics, and nitrogen-containing compounds are generally many times higher than vapor pressures for pesticides and PCBs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization is a significant loss process for volatile organics in surface water or surface soil. Volatilization is not significant for inorganics. Surface soils at the base do not contain high concentrations of volatile organics. This fact most likely indicates that volatilization has occurred from surface spills and surface disposal of volatile chemicals.

3.2.1.3 Solubility

The rate at which a chemical is leached from a waste deposit by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. The water solubilities presented in Table 3-2 indicate that the volatile organic chemicals (ketones, monocyclic aromatics, and halogenated aliphatics) and nitrogen-containing compounds are usually several orders of magnitude more water-soluble than the pesticides and PCBs. The groundwater data show that the various types of volatile organics are the predominant contaminants.

The solubility of inorganics is strongly influenced by their valence state(s) and forms (hydroxides, oxides, carbonates, etc.). The solubility is also dependent on pH, Eh, and other ionic species in solution (the Debye-Huckel theory). The solubility products reported in the literature vary with the type of complex

formed, but generally it can be noted that, for example, cadmium and copper complexes are more soluble than lead and nickel complexes.

3.2.1.4 Octanol/Water Partition Coefficient

The octanol/water partition coefficient (K_{ow}) is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between the K_{ow} and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor) has been determined (Lyman et al., 1990). It is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available. Pesticides and PCBs are several orders of magnitude more likely to partition to fatty tissues than the more soluble volatile organics. The K_{ow} is also used to estimate bioconcentration factors in aquatic organisms.

3.2.1.5 Organic Carbon Partition Coefficient

The organic carbon partition coefficient (K_{oc}) indicates the tendency of a chemical to bind to soil particles containing organic carbon. Chemicals with high K_{oc} 's generally have low water solubilities and vice versa. This parameter may be used to infer the relative rates at which the more mobile chemicals (ketones, monocyclic aromatics, and halogenated aliphatics) are transported in the groundwater. Chemicals such as most pesticides, PAHs, and PCBs are relatively immobile in the soil and are preferentially bound to the soil. These compounds are not subject to groundwater transport to the extent that compounds with higher water solubilities are. However, these immobile chemicals are easily transported by erosional processes when they are present in surface soils.

3.2.1.6 Henry's Law Constant

Both the vapor pressure and the water solubility are of use in determining volatilization rates from surface water bodies and from groundwater. The ratio of these two parameters (the Henry's Law constant) is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant of less than $5E-6$ atm-m³/mole, such as pesticides and PCBs, should volatilize very little and be present only in minute amounts in the atmosphere or soil gas. For chemicals with a Henry's Law constant greater than $5E-3$ atm-m³/mole, such as many of the halogenated aliphatics, volatilization and diffusion in soil gas could be significant.

3.2.1.7 Bioconcentration Factor

The bioconcentration factor (BCF) represent the ratio of aquatic-animal-tissue concentration to water concentration. The ratio is both contaminant- and species-specific. When site-specific values are not measured, literature values are used or the BCF is derived from the octanol/water coefficient. Many of the pesticides and PCBs will bioconcentrate at levels 3 to 5 orders of magnitude greater than those concentrations found in the water, whereas volatile organics and nitrogen-containing compounds are not as readily bioconcentrated.

3.2.1.8 Distribution Coefficient

The distribution coefficient (K_d) is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the K_{oc} and the amount of organic carbon in the soil. For ions (e.g., metals), K_d is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. Distribution coefficients for metals vary over several orders of magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges. Soil and clay distribution coefficients for inorganics are shown in Table 3-3.

3.2.2 Contaminant Persistence

The persistence of various classes of chemicals is discussed in this section. Several transformation mechanisms affect chemical persistence, such as hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions. The following general classes of compounds are discussed:

- Ketones
- Monocyclic aromatics
- Halogenated aliphatics
- Polycyclic aromatic hydrocarbons (PAHs)
- Phthalate esters
- Pesticides
- Polychlorinated biphenyls (PCBs)
- Nitrogen-containing compounds

- Chlorinated dibenzo-p-dioxins (CDDs)
- Metals

3.2.2.1 Ketones

Ketones are highly volatile and soluble, and these two processes dominate the fate of these compounds in the environment. Ketones are not considered to be persistent in the environment, particularly in comparison to chemicals such as PCBs and pesticides. Hydrolysis is generally not a significant fate process for this class of chemicals, nor is bioconcentration significant, based on the low K_{ow} s (Howard, 1990).

Acetone is completely miscible in water and is unlikely to adsorb to soil or sediments or bioaccumulate. It has a high vapor pressure and once released to the air, photolysis and reaction with hydroxyl radicals result in an average half-life of 22 days (Howard, 1990).

2-Butanone will partially evaporate into the atmosphere if released to the soil, and may also leach into the groundwater. Once in the groundwater, 2-butanone may slowly degrade. In surface water, 2-butanone has a half-life of approximately 3 to 12 days. Hydrolysis, photolysis, bioconcentration, and adsorption are not significant fate processes for this chemical (Howard, 1990).

4-Methyl-2-pentanone may be removed from soil by direct photolysis, volatilization, or aerobic biodegradation. It is also susceptible to leaching and may be found in groundwater. If released to surface water, it has a volatilization half-life of 15 to 33 hours, and is also subject to direct photolysis. This compound does not significantly bioconcentrate, oxidize, hydrolyze, or adsorb to soil (Howard, 1990).

3.2.2.2 Monocyclic Aromatics

Monocyclic aromatic compounds such as benzene, toluene, chlorobenzene, and xylenes are not considered to be persistent in the environment, particularly in comparison to chemicals such as PCBs and pesticides. Monocyclic aromatics are subject to degradation via the action of both soil and aquatic microorganisms. The biodegradation of these compounds in the soil matrix is dependent of the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, etc.

Although these compounds are amenable to microbial degradation, it is not anticipated that degradation will occur at an appreciable rate, although macronutrient availability is not known. In the event that these compounds discharge to surface water bodies, volatilization and biodegradation may occur relatively rapidly.

For example, a reported first-order biodegradation rate constant for benzene is 0.11 day^{-1} in aquatic systems (Lyman et al., 1990). This corresponds to an aquatic half life of approximately 6 days. Other monocyclic aromatics are subject to similar degradation processes in aquatic environments (USEPA, December 1982). However, chlorinated monocyclic aromatics such as chlorobenzene are not expected to be as susceptible to microbial degradation. For example, a reported first-order biodegradation rate constant for chlorobenzene is 0.0045 day^{-1} in aquatic systems (Lyman et al., 1990, which corresponds to an aquatic half-life of approximately 150 days.

Benzene in groundwater is significantly reduced by the action of aerobic bacteria. A biodegradation rate of 0.95%/day has been reported (Chiang et al., 1989). The amount of benzene, toluene, and xylenes in the groundwater was reported to be directly proportional to the availability of dissolved oxygen.

Additional environmental degradation processes, such as hydrolysis and photolysis, are considered to be insignificant fate mechanisms for monocyclic aromatics in aquatic systems (USEPA, December 1982). However, some monocyclic aromatics such as benzene and toluene have been shown to undergo clay-, mineral-, and soil-catalyzed oxidation (Dragun, 1988).

3.2.2.3 Halogenated Aliphatics

Halogenated aliphatic hydrocarbons such as 1,1,2,2-tetrachloroethane and trichloroethene are subject to abiotic dehydrohalogenation. This process is an elimination reaction that results in the formation of an ethene from a saturated halogenated compound (Olsen and Davis, 1990). Therefore the presence of dichloroethane in groundwater in association with ethanes may be a result of this process. Research indicates that microbial degradation of highly chlorinated ethanes is a relatively slow process. 1,1,1-trichloroethane has been shown to break down to 1,1-dichloroethane and chloroethane (Smith and Dragun, 1984), with half-lives reported on the order of 6 to 8 months. Hydrolysis, photolysis, and oxidation are generally not considered to be significant fate processes for the chlorinated ethanes.

While trichloroethene is reportedly susceptible to degradation, the primary end product is reportedly vinyl chloride, which degrades slowly (Cline and Viste, 1984). It does not appear that appreciable degradation of halogenated aliphatics occurs in aerobic aquatic systems (USEPA, December 1982) or in unsaturated soils (Lyman et al., 1990).

Photolysis is not considered to be a relevant degradation mechanism for this class of compounds (USEPA, December 1982). Limited hydrolysis of saturated aliphatics (i.e., alkanes) may occur, but it does not appear to be a significant degradation mechanism for unsaturated species (i.e., alkenes) (USEPA, December 1982).

Under certain conditions, volatilization is a significant fate process for these compounds. Volatilization is only significant at the air-soil or air-water interface. Adsorption should not be considered as an important fate for these types of compounds when compared to more hydrophobic compounds (PCBs for example).

3.2.2.4 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs have very low solubilities, vapor pressures, and Henry's Law constants, and high K_{oc} s and K_{ow} s. The low-molecular-weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene) may volatilize from surface waters, while the high-molecular-weight PAHs (e.g., benzo(a)pyrene, benzo(a)anthracene, chrysene, etc.) are less likely to volatilize. PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than to go into solution. PAHs are subject to degradation via aerobic bacteria, but may be relatively persistent in the absence of microbial population or macronutrients such as phosphorus and nitrogen.

Bioconcentration of PAHs in aquatic organisms is greater for the higher-molecular-weight compounds than the lower-molecular-weight compounds. PAHs can be bioaccumulated from water, sediments, or lower organisms in the food chain.

Landspreading applications have indicated that PAHs are highly amenable to microbial degradation in soil. The rate of degradation is influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (ATSDR, October 1989c).

The most important fate of PAHs in water are photo-oxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene, chrysene, fluorene, and pyrene are reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonation, and may be metabolized by microbes under oxygenated conditions (ATSDR, October 1989c).

3.2.2.5 Phthalate Esters

Phthalate esters are considered to be relatively persistent chemicals in the environment. Although numerous studies have demonstrated that phthalate esters undergo biodegradation, it appears that this is a slow process in both soils and surface waters. Certain microorganisms have been shown to excrete products that increase the solubility of phthalate esters and enhance their biodegradation (Gibbons and Alexander, 1989).

Biodegradation of bis(2-ethylhexyl)phthalate and other phthalates in water is an important fate mechanism, with a half-life of 2 to 3 weeks reported for bis(2-ethylhexyl)phthalate (Howard, 1989). Bioaccumulation is also a significant fate process. Hydrolysis of phthalate esters is very slow, with calculated half-lives of 3 years (dimethylphthalate) to 2000 years (bis(2-ethylhexyl)phthalate) (USEPA, December 1979). Similarly, photolysis and volatilization are considered to be insignificant degradation mechanisms (USEPA, December 1979; Howard, 1989).

3.2.2.6 Pesticides

Whether pesticides are sprayed, dusted, or applied directly to the soil, the soil is the ultimate sink for these chemicals. Surface soil runoff may carry pesticides to adjacent surface water bodies. Bioconcentration of pesticides in the food chain is another important fate mechanism. Hydrolysis, oxidation, and photolysis are not generally important fate mechanisms for pesticides in soil or water. Hydrolysis half-lives for several pesticides are reported in periods of months to years (USEPA, December 1979). Some of the more commonly detected pesticides are discussed below.

- 4,4'-DDT and its metabolites are considered to be persistent chemicals. They undergo extensive adsorption to soil and are not highly soluble. Biodegradation may occur under both aerobic and anaerobic conditions in the presence of certain soil microorganisms. Under aerobic conditions, 4,4' DDT may be transformed to DDE, while under anaerobic conditions, 4,4' DDD may result. These compounds are, however, somewhat volatile, with a reported half-life of 100 days for 4,4' DDT. These compounds are highly lipophilic and therefore readily bioaccumulate (ATSDR, October 1992c). 4,4' DDT is no longer in production in the United States.
- Dieldrin is an extremely persistent pesticide, but is no longer registered for general use. In soil, dieldrin will persist for long periods of time (more than 7 years), and may slowly evaporate. It

does not readily leach to groundwater. Once in surface waters (via runoff), dieldrin adsorbs strongly to sediments and bioconcentrates, and slowly photodegrades. Biodegradation and hydrolysis are not significant (Howard, 1991).

- The use of heptachlor was restricted to underground termite control in 1983. Heptachlor epoxide is formed by the biological transformation of heptachlor in the environment. These compounds sorb strongly to soil. Heptachlor is subject to biodegradation (forming heptachlor epoxide, which is highly resistant to biodegradation) and hydrolysis. Bioconcentration of both compounds is significant, while volatilization and photolysis are very slow (Howard, 1991).
- Methoxychlor will remain in the soil and does not leach significantly. It degrades more rapidly under anaerobic conditions (less than 28-day half-life in sediments) than in aerobic conditions (more than 100-day half-life in sediments). In water, methoxychlor may adsorb to sediments or it may bioaccumulate, although fish are reported to metabolize methoxychlor fairly rapidly (Howard, 1991).

3.2.2.7 Polychlorinated Biphenyls (PCBs)

PCBs are considered to be very persistent organic chemicals. Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded (USEPA, December 1979). Although some microorganisms (e.g., *Phanaerochaete chrysosporium*) may biodegrade PCBs, such fungi may not exist in local soil. There is experimental evidence to suggest that heavier PCBs (five or more chlorines per molecule) can undergo photolytic degradation, but there are no data to suggest that this process operates under environmental conditions (USEPA, December 1979). Base-, acid-, and neutral-promoted hydrolysis are considered to be inconsequential degradation mechanisms for PCBs (USEPA, December 1982).

3.2.2.8 Nitrogen-Containing Compounds

Nitrogen-containing compounds such as N-nitrosodiphenylamine are subject to significant biodegradation in both soil and water. The addition of soil amendments can significantly enhance biodegradation rates. No studies of hydrolysis and oxidation are available (ATSDR, October 1991i), but are not thought to be significant (USEPA, December 1979). In addition, volatilization is not significant.

The most probable fate of 3,3'-dichlorobenzidine in surface water is adsorption to particulates and sediments. Photolytic dechlorination is rapid in shallow water. Biodegradation and volatilization are not significant in surface waters (USEPA, December 1979). When released to soil, it will sorb to soil particles and may undergo chemical reactions with soil components. Very slow mineralization may occur (Howard, 1989).

3.2.2.9 Chlorinated Dibenzo-p-Dioxins (CDDs)

Little information is available on the fate of octachlorodibenzo-p-dioxin in the environment. However, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is expected to be fairly immobile in soil. Leaching through the soil column is possible in soils of very low organic carbon content as a result of solvation or biotic mixing by earthworms. A white rot fungus (*Phanaerochaete chrysosporium*) has been shown to degrade TCDD, but this process is not reported in natural soil. Additionally, photoreaction and volatilization may remove some TCDD from soil surfaces (ATSDR, November 1987b).

3.2.2.10 Metals

Metals are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

The mobility of metals is influenced primarily by their physical and chemical properties in combination with the physical and chemical characteristics of the soil matrix. Factors that assist in predicting the mobility of inorganic species are the soil/pore water pH, soil/pore water Eh, and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity.

3.2.3 Contaminant Fate and Transport

This section presents a brief overview of contaminant fate and transport issues at NSB-NLON. Site-specific concerns are contained in Sections 5.0 through 17.0. This discussion focuses on some of the major types of contaminants found at the site.

3.2.3.1 Volatile Organics

Volatile organic chemicals are typically considered to be fairly soluble and have a low capacity for retention by soil organic carbon, and therefore are the organic compounds most frequently detected in groundwater. These types of chemicals may migrate through the soil column after being released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some portion of these chemicals is retained by the soil, but most will continue migrating downward until they reach the water table. At that time, migration is primarily laterally with the hydraulic gradient. Again, some portion of the chemical may be retained by the saturated soil.

Several of these compounds have specific gravities less than that of water (e.g., benzene, toluene). These compounds are typically found in fuels, and if a large enough fuel spill occurs, these compounds may move through the soil column as a bulk liquid, until they reach the water table. There, instead of going into solution, the majority of the release may remain as a discrete fuel layer on the water table surface, with some of the material going into solution at the water/fuel interface.

Similarly, compounds with specific gravities greater than that of water (e.g., trichloroethene) are often used in various industrial applications such as degreasing. If a large enough spill of these solvents occurs, they may also migrate as a bulk liquid, but will not stop at the water table.

3.2.3.2 Polynuclear Aromatic Hydrocarbons

PAHs are generally considered to be fairly immobile chemicals in the environment. They are large molecules with high organic carbon partition coefficients and low solubilities when compared to the volatile organics. These compounds, when found in the soil, generally do not migrate vertically to a great extent. Instead, they are more likely to adhere to soil particles and be removed from the site via surface runoff and erosional processes.

3.2.3.3 Pesticides

Pesticides were widely used at this installation. Many of the compounds detected are no longer licensed for general sale and use in the United States. Therefore, it is assumed that much of what was detected at the various sites are representative of past application for insect control.

Like the PAHs, pesticides as a class of compounds are not considered to be very mobile in the environment. These chemicals, upon application or disposal, tend to remain affixed to soil particles. Migration of pesticides occurs primarily by erosion via the action of wind or water.

3.2.3.4 Inorganics

Because metals are frequently incorporated into the soil matrix and remain bound to particulate matter, they also migrate from the source areas via bulk movement processes (erosion). The larger particles (> 0.45 microns, which are removed via the filtration step prior to water analysis) are not generally considered to be mobile in groundwater. The metals detected in unfiltered groundwater samples are likely to be representative of suspended soil material in the samples.

There are some instances, however, where these metals are found at such concentrations or in such form as to be able to migrate in solution. It is possible that industrial activities could saturate all available exchange sites in soil and hence a metal may be mobilized. Metals are also more mobile under acidic conditions, which may exist in areas where plating-type activities have occurred. Finally, a metal solution may be utilized in some industrial applications. In these cases, it is possible for metals to migrate vertically through the soil column and reach the groundwater.

3.3 HUMAN HEALTH RISK ASSESSMENT PROCEDURES

A risk assessment provides the framework for developing risk information necessary to assist in developing potential remedial alternatives for a site. A baseline human health risk assessment consists of five major components, as follows:

- Data evaluation and identification of chemicals of concern
- Identification of significant exposure pathways
- Toxicity assessment
- Estimation of potential public health risks
- Characterization of uncertainty in the risk estimates

To assess potential public health risks, three major aspects of chemical contamination and exposure must be considered: (1) chemicals with toxic characteristics must be identified in environmental media and be released by either natural processes or human action; (2) pathways by which actual or potential exposure occurs must be present; and (3) human receptors must be present at the point of exposure to complete the

exposure route. Risk is a function of both toxicity and exposure; without one of the factors listed above, there is no risk.

The risk assessment for the NSB-NLON estimates the potential for human health risk at each site individually. Information on the distribution of contamination, the toxicity of the compounds detected in the various media, and a site-specific estimate of chemical intake via assumed exposure routes are combined in each of Sections 5.0 through 17.0 to estimate potential risks. This section provides a summary of the process used, and all information that would have to be repeated from section to section in order to avoid redundancy in the document. The risk assessment conducted for this base follows the most recent guidance from the USEPA (USEPA, December 1989 and March 25, 1991), including Regional guidance (USEPA Region I, August 1995, August 1994, and June 1989).

The Data Evaluation Section is primarily concerned with the selection of Chemicals of Concern (COCs) that are representative of the type and magnitude of potential human health effects. Both the most current and historical data are considered to develop a list of COCs for each medium. In turn, these COCs are used to evaluate potential risks. A generic discussion of the process is contained in Section 3.3.1, while site-specific discussions are presented in the subsequent sections.

The toxicity assessment presents the available human health criteria for all the selected COCs. This assessment is contained in Section 3.3.2, although the final lists of COCs are presented throughout the document. This section is presented early to avoid repetition of the toxicity information when the chemicals are repeated from site to site. Quantitative toxicity indices are presented where they are available. Enforceable standards such as Maximum Contaminant Levels (MCLs), regulatory guidelines such as Ambient Water Quality Criteria (AWQC) and Health Advisories, and dose-response parameters such as Reference Doses (RfDs) and Cancer Slope Factors (CSFs) are presented for each COC.

The Exposure Assessment section identifies potential human exposure pathways at the source areas under consideration. Exposure routes are developed from information on source area chemical concentrations, chemical release mechanisms, patterns of human activity, and other pertinent information to develop conceptual site models for each type of source. One overall set of exposure routes was developed for the base, but not all routes are applicable to all sites. Section 3.3.3 presents the equations and relevant input parameters for estimating chemical intake, and the site-specific risk assessments present only those routes relevant to each site, and refer to Section 3.3.3 for the details on the estimation method.

The Risk Characterization section (Section 3.3.4) describes how the estimated intakes are combined with the toxicity information to estimate risks. The actual numerical results of this exercise are presented in the site-specific sections of this report. General uncertainties associated with the risk assessment process are discussed qualitatively in Section 3.3.5. Uncertainties associated with a particular site are provided in the site-specific sections.

3.3.1 Data Evaluation

Data evaluation is a site-specific task that uses a variety of information to determine which of the detected chemicals at a site are most likely to present a risk to potential receptors. The end result of this qualitative selection process is a list of COCs for each medium under consideration. The rationale for the selection and/or exclusion of each detected chemical is presented in the site-specific sections that follow.

COCs for the baseline human health risk assessments are limited to those chemicals that exceed a selection criterion. For this risk assessment, risk-based criteria were used to reduce the number of chemicals and exposure routes considered in a risk assessment. The premise of this screening step is that risk is typically dominated by a few chemicals and that while dozens may actually be detected, many chemicals may contribute minimally to the total risk.

The risk-based COC screening criteria used in the human health risk assessment were based on USEPA Region III COC screening guidance (USEPA Region III, March 1994), which developed absolute risk-based concentrations (rather than the relative concentration-toxicity screen described by the USEPA in the Risk Assessment Guidance for Superfund) for nearly 600 chemicals in air, drinking water, fish tissue, and soil using certain default exposure routes. Current dose-response parameters were also employed in developing the screening criteria. The tap water ingestion values were used to screen the surface water and groundwater concentrations at NSB-NLON, the fish tissue concentrations were used to screen the biota data (oysters, clams, and estimated finfish tissue concentrations), and the residential soil ingestion concentrations were used to screen the soil and sediment data collected from each site. In addition, for air samples collected at the Nautilus Museum (Goss Cove Landfill site), ambient air values were used to identify COCs. The COC screening values used in the risk assessment are provided in Table 3-4 (groundwater and surface water), Table 3-5 (soil, sediment, shellfish, and finfish), and Table 3-6 (air). Other health-based standards are included in these tables to indicate, in general, the conservative nature of the risk-based COC screening criteria.

The criteria developed by USEPA Region III are based on reasonably expected maximum exposures that reflect the reasonable maximum receptor's characteristics as defined by the USEPA Region I (see Section 3.3.3). The criteria for carcinogenic compounds are based on a $1E-6$ incremental lifetime cancer risk, as calculated by the Region. The criteria for noncarcinogenic compounds were estimated to represent a Hazard Quotient of 0.1, which is already one-tenth of the suggested total noncarcinogenic "risk" to a potential receptor. This estimation of risk is described in greater detail in Section 3.3.4.

The tap water criteria are based on an age-adjusted ingestion rate for small children (1 L/day for 6 years) and adults (2 L/day for 24 years) to cover a 30-year exposure period and inhalation of volatiles from showering (inhalation rates of $12 \text{ m}^3/\text{day}$ for 6 years and $20 \text{ m}^3/\text{day}$ for 24 years). The screening values for fish tissue were based on an ingestion rate of 54 g/day, 350 days/year for 30 years. The criteria for residential soil exposure are based on an age-adjusted soil ingestion rate for carcinogens (200 mg/day for 6 years and 100 mg/day for 24 years) and childhood exposure only (200 mg/day for 6 years) for noncarcinogens. No distinction was made in the COC selection between employee, construction personnel, and future potential residential exposures. In other words, if a chemical was selected as a COC based on the residential soil screening value, it was also considered for all potential receptors and exposures in order to simplify the risk assessment process and reduce confusion. Additional details on the calculation methodology are presented in Appendix F.2

Maximum detected concentrations at each site and in each medium were compared to the risk-based COC screening criteria. If the maximum concentration exceeded the criterion, that chemical was retained as a COC for all exposure routes involving that medium. For example, if barium were retained for soil, it was evaluated as a COC for both ingestion and dermal exposure routes. If no detected chemical exceeded a criterion, that medium was dropped from further consideration. For example, if no detected chemicals in sediment exceeded the residential soil criteria, then sediment contact (ingestion and dermal) was not considered quantitatively in the risk assessment for that site.

COCs were selected for surface soil (0 to 2 feet) and "all soil". "All soil" is a category of soil from depths of 0 to 10 feet which accounts for soil to which a construction worker and future residents are potentially exposed. If a chemical is identified as a COC for surface soil, it is automatically retained as a COC for "all soil." If a compound is found only in the subsurface soil at a concentration of concern (i.e., exceeding the screening value), it is retained as a COC for the "all soil" category only.

In general, all available data from the Phase I and II RIs and additional investigations were used to identify COCs for a site. Site- and media-specific COC summary screening tables are provided in Appendix F.4

through F.16. Field screening data, unvalidated data, and analytical results qualified as rejected, R, during the data validation process were not considered because of their potential unreliability. COCs for groundwater and surface water were selected based on filtered, as well as unfiltered, sample results. For soil, data obtained from excavated locations, soil collected from depths greater than 10 feet, and composite samples were not used in the COC selection process.

As per USEPA Region I guidance (USEPA, August 1995d), background soil concentrations, developed by Atlantic Environmental Services, Inc., and presented in Section 1.2.3.9, were not used to eliminate COCs. All soil COCs were retained to provide a complete characterization of risk. A comparison of site data to the established background levels is provided in each site-specific uncertainty section.

According to the Regional guidance, risk assessments are conducted using a representative concentration for each COC (except when assessing exposure to groundwater, where the maximum detected concentration and the average plume concentration are used as exposure concentrations). The representative concentration is defined as the upper 95 percent confidence limit (UCL) and is calculated using the latest risk assessment guidance from the USEPA (USEPA, May 1992g). A value of one-half the detection limit is substituted in the calculation for nondetected values. Because of potential problems with sample heterogeneity, the maximum detected concentration for field duplicate pair samples was used in the calculation for soil and sediment matrices at the direction of the USEPA. The average for the duplicate pair was employed for aqueous matrices.

For sample sets consisting of less than 10 samples, the maximum and average concentrations were used as the representative concentrations since the UCL does not provide a good estimation of the upper bound of the mean concentration for these small data sets (USEPA, May 1992g). For larger sample sets, the methodology used is dependent on the distribution of the sample set. For this risk assessment, the distribution was determined using the Shapiro-Wilk W-Test (Gilbert, 1987). When the results of the test were inconclusive and the distribution was regarded as undefined, maximum and average detections were used as exposure concentrations.

For normally distributed data, the calculation of the representative concentration (UCL) is a two-step process. First the standard deviation of the sample set must be determined, as follows:

$$S = \left[\frac{\sum (X_i - \bar{X})^2}{(n-1)} \right]^{1/2}$$

where: S = Standard deviation
 X_i = Individual sample value
 n = Number of samples
 \bar{X} = Mean sample value

The one-sided UCL on the mean is then calculated as follows:

$$UCL = \bar{X} + t \left[\frac{S}{n^{1/2}} \right]$$

where: UCL = 95% Upper confidence limit of the mean
 \bar{X} = Arithmetic average
 t = One-sided t distribution factor ($t_{0.95}$)
 S = Standard deviation
 n = Number of samples

For log-normally distributed data sets, the representative concentration is calculated using the following equation:

$$UCL = \exp \left[\bar{X} + 0.5S^2 + \frac{HS}{(n-1)^{1/2}} \right]$$

where: UCL = 95% Upper confidence limit of the mean
 exp = Constant (base of the natural log, e)
 \bar{X} = Mean of the transformed data
 S = Standard deviation of the transformed data
 H = H-statistic (from Gilbert, 1987; $H_{0.95}$)
 n = Number of samples

This equation uses individual sample results that have been transformed by taking their natural logarithm.

As mentioned previously, average and maximum plume concentrations were used as the representative concentrations for assessing risks associated with groundwater exposure. Because of the multiple rounds of groundwater sampling which were performed at some of the sites investigated in this RI Report, the first step in developing exposure concentrations for this medium was to determine an average chemical

concentration for each well (using the one-half detection limit for nondetected results). The maximum plume concentration was defined as the highest average in a single well. The average of all of the well-specific averages was considered to represent the average plume concentration.

Sample calculations for the determination of the distribution of a data set, UCL, and average and maximum plume concentrations are provided in Appendix F.3.

3.3.2 Toxicity Assessment

The toxicity assessment for the COCs examines information concerning the potential human health effects of exposure to COCs. The goal of the toxicity assessment is to provide, for each COC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 3.3.3) to characterize the potential for the occurrence of adverse health effects (Sections 3.3.4 and the site-specific sections).

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical, and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the chemicals of concern.

The entire toxicological data base is used to guide the derivation of cancer slope factors (CSFs) for carcinogenic effects and Reference Doses (RfDs) for noncarcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and comparisons of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of toxicity data used to derive CSFs and RfDs comes from animal studies.

For noncarcinogenic effects, the most appropriate animal model (i.e., the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such data, however, an RfD for one route of exposure may be extrapolated

from data from a study that used a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological data base, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicologic similarity.

CSFs for weight-of-evidence Group A or B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C compounds for which the data are sufficient, but are not derived for Group D or E chemicals. No consideration is given to similarity in the animal and human target organ(s), because a chemical capable of inducing cancer in any animal tissue is considered potentially carcinogenic to humans. Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Toxicological profiles for each of the COCs are presented in Appendix E. These profiles present a summary of the available literature on carcinogenic and noncarcinogenic effects associated with human exposure to the chemical. Brief summaries of the toxicity profiles for the major COCs are presented in Section 3.3.2.3.

3.3.2.1 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes: (1) a weight-of-evidence classification and (2) a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of three groups in USEPA's classification system to denote its potential for carcinogenic effects:

- Group A - known human carcinogen
- Group B1 or B2 - probable human carcinogen
- Group C - possible human carcinogen

Chemicals that cannot be classified as a human carcinogen because of a lack of data are placed in Group D, and those for which there is evidence of noncarcinogenicity in humans are in Group E.

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined as the upper bound estimate of the probability of cancer incidence per unit dose averaged over a lifetime. Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals, and are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens have none (e.g., lead). Slope factors are specific to a chemical and route of exposure and are expressed in units of $(\text{mg/kg/day})^{-1}$ for both oral and inhalation routes. Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal $\mu\text{g}/\text{m}^3$ ($1/\mu\text{g}/\text{m}^3$). Because cancer risk characterization requires an estimate of reciprocal dose in units of $1/\text{mg/kg/day}$, the inhalation unit risk must be converted to the mathematical equivalent of an inhalation cancer slope factor, or risk per unit dose (mg/kg/day). This is done by assuming that humans weigh 70 kg and inhale 20 m^3 of air per day [i.e., the inhalation unit risk ($1/\mu\text{g}/\text{m}^3$) is divided by 20 m^3 , multiplied by 70 kg, and multiplied by 1,000 $\mu\text{g}/\text{mg}$ to yield the mathematical equivalent of an inhalation slope factor ($1/\text{mg/kg/day}$)]. CSFs for COCs at NSB-NLON are presented in Table 3-7. The primary sources of information for these values are the USEPA (December 1995f) and USEPA Region III (October 1995e).

USEPA's database (IRIS - the Integrated Risk Information System) was consulted as the primary source for CSF values, as well as for RfDs. The USEPA intends that IRIS supersede all other sources of toxicity information for risk assessment. If values are not available in IRIS, the annual Health Effects Assessment Summary Tables (HEAST) were consulted, as well as the current USEPA Region III Risk-Based Concentration table (USEPA Region III, October 1995e). If no CSF is available from any of these sources, carcinogenic risks are not quantified and potential exposures are addressed in the general uncertainty section, Section 3.3.5.

Cancer slope factors also exist for several (but not all) Class C compounds, which are identified as "possible" human carcinogens. These compounds typically exhibit inadequate evidence of carcinogenicity in humans and limited evidence in animals. In this human health risk assessment, Class C compounds are evaluated the same as A/B1/B2 compounds, but the risks associated with exposure to Class C compounds are also discussed separately if they are major risk drivers, underscoring the uncertainty associated with these estimations.

Dermal CSFs are derived from the corresponding oral values. In the derivation of a dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Table 3-7. When no absorption rate is available in the literature, no adjustment is made.

Current USEPA risk assessment guidance for PCBs (USEPA, September 1996) was used to evaluate the carcinogenic effects associated with exposure to PCBs. Prior to development of the USEPA guidance, risk assessments were conducted using a single, default CSF (7.7 kg/day/mg), which was applied to all Aroclors regardless of the congeners present in the chemical mixture. Because of the observed differences in toxicity, mobility, and interaction in environmental processes for the various PCB congeners, specific CSFs have been developed for representative classes of environmental PCB mixtures and different exposure pathways using a tiered approach. Different CSFs are presented in the current guidance for CTE and RME evaluation. For the purposes of this risk assessment, CSFs associated with "high risk and persistence" were used to assess the potential risks for exposure to PCBs in soil and sediment. CSFs associated with "low risk and persistence" were used to assess the potential risks for exposure to PCBs in groundwater and surface water.

Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. While benzo(a)pyrene was well studied, other Class B2 PAHs had insufficient data with which to calculate a CSF. Recently, the USEPA published provisional guidance to assess PAHs (USEPA, July 1993g). Estimated orders of potential potency (rather than a toxicity equivalence factor or TEF) were developed based on skin painting tests and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin). The quality of the data does not support any greater precision. The orders of potential potency used in this health risk assessment are presented in Table 3-8 and are those proposed for use by the USEPA Region I (August 1994m).

The USEPA has determined that the CSF for benzo(a)pyrene is $7.3 \text{ (mg/kg/day)}^{-1}$, and that no acceptable inhalation unit risk factor exists for this compound. Therefore, the guidance is applicable only to oral exposure. There is "no basis for judgment that benzo(a)pyrene or other PAHs will be equipotent by oral and inhalation routes" (USEPA, July 1993g). The effects of particulates and cocarcinogens on benzo(a)pyrene effects in the lungs have not been addressed, thereby preventing establishment of an inhalation potency for benzo(a)pyrene and relative potencies for other PAHs.

The USEPA has determined that extrapolation of the oral cancer slope factor for benzo(a)pyrene to dermal exposure is not appropriate because this compound causes skin cancer through direct action at the point of application. It is uncertain whether the oral slope factor would be sufficiently protective against the local carcinogenic effect of dermally applied benzo(a)pyrene (USEPA, undated). The same conclusion is therefore applied to other B2 PAHs for this risk assessment, because their cancer slope factors are based on that for benzo(a)pyrene.

Interim toxicity equivalence factors (TEFs) have been developed to estimate the hazard and dose-response of complex mixtures containing chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs), in addition to 2,3,7,8-TCDD, which provides the relative basis for other related compounds. USEPA's Risk Assessment Forum concluded that a reasonable estimate of the risks associated with exposure to a mixture of CDDs and CDFs can be made by considering the distribution of CDD/CDF congeners and the likely relative toxicity of these compounds (USEPA, March 1989c). These values are presented in Table 3-9.

3.3.2.2 Noncarcinogenic Effects

For noncarcinogens, it is assumed that there exists a dose below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. For noncarcinogens, a range of exposure exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for noncarcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to a Reference Dose (RfD). The RfD is expressed in units of mg/kg/day, and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs. Separate RfDs are presented for ingestion and inhalation pathways. In particular, Reference Concentrations (RfCs) in units of mg/m³ are typically presented for the inhalation pathway. Because characterization of noncarcinogenic effects requires an estimate of dose in units of mg/kg/day, the inhalation RfC must be converted to an inhalation RfD. This is done by assuming that humans weigh 70 kg and inhale 20 m³ of air per day [i.e., the inhalation RfC (mg/m³) is multiplied by 20 m³/day and divided by 70 kg to yield an inhalation RfD (mg/kg/day)].

To derive an RfD, the USEPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the

no-observed-adverse-effect-level (NOAEL) or, if the data are inadequate for such a determination, the lowest-observed-adverse-effect-level (LOAEL). The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect". To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for (1) extrapolation of data from laboratory animals to humans (interspecies extrapolation), (2) variation in human sensitivity to the toxic effects of a compound (intraspecies differences), (3) derivation of a chronic RfD based on a subchronic rather than a chronic study, and/or (4) derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed from an oral RfD by multiplying by the gastrointestinal tract absorption factor. The resulting dermal RfD is, therefore, based on absorbed dose, which is what is calculated by the dermal exposure algorithms.

Reference Doses for the COCs at NSB-NLON are presented in Table 3-10. The primary source of these values is the IRIS database, followed by other USEPA sources described for the carcinogens. This table also includes the primary target organs affected by a particular chemical. This information may be used in the Risk Characterization section to segregate risks by target organ effects, unless the total Hazard Index is below unity. This ensures that "risks" are not overestimated when different compounds affect different target organs.

3.3.2.3 Toxicity Summaries for Major Chemicals of Concern

This section contains brief summaries of the toxicological profiles for the major COCs. The detailed profiles are contained in Appendix E.

PAHs. Benzo(a)pyrene is the most widely studied chemical in this class. It is used as the basis for defining the toxicity of other potentially carcinogenic PAHs. Benzo(a)pyrene is widely distributed in the tissues of treated rats and mice, but is primarily found in tissues high in fat. While the carcinogenicity of complex mixtures containing PAHs (such as coal tar, coke oven emissions, and cigarette smoke) is suggested, the carcinogenicity cannot be attributed solely to PAHs. The carcinogenicity of benzo(a)pyrene is based largely

on the results of animal studies in which the animals were exposed to large doses of purified compound via unnatural routes of exposure.

The noncarcinogenic PAHs appear to affect the liver, kidneys, and blood of exposed laboratory animals. Exposure routes considered include ingestion and inhalation, and exposure has resulted in anemia and mild liver lesions and occasionally renal disease. The effects vary for the individual compounds.

DDT. The production and sale of DDT in the United States was canceled in 1972. DDT concentrates in fatty tissues, and is slowly eliminated. DDT degrades in the body to DDE and DDD. Acute exposure to DDT affects the central nervous system, resulting in tremors, headache, and nausea. No evidence has been presented that DDT has caused cancer in persons handling or spraying DDT, however, the USEPA has classified 4,4'-DDT as a B2 carcinogen.

Arsenic. Organic and inorganic arsenic compounds are almost completely absorbed upon ingestion. Arsenic is distributed to the liver, kidneys, and lungs, then redistributed to the hair, nails, teeth, bone, and skin. Acute oral exposure to arsenic causes liver swelling, skin lesions, and neurological effects. The only noncarcinogenic effects clearly attributable to chronic oral exposure are dermal hyperpigmentation and keratosis. Inhalation of arsenic causes lung cancer, and the USEPA has classified arsenic as a Class A carcinogen via this route of exposure. Oral exposure to high concentrations in water is associated with an increased risk of skin cancer, which is not generally lethal.

Beryllium. Beryllium is poorly absorbed from the gastrointestinal tract, and therefore has low toxicity upon oral exposure. Occupational exposure has resulted in dermatitis and berylliosis (acute pulmonary granulomatosis). Inhalation exposure and intratracheal instillation have caused lung tumors in rats and monkeys, and therefore the USEPA classifies beryllium as a B2 carcinogen. The oral studies have yielded inconclusive results.

Lead. Lead is efficiently absorbed by children. The fate of lead in the body depends in part on the amount and rate of previous exposures, the age of the receptor, and the rate of exposure. The principal effects of acute oral exposure are colic, anemia, and in severe cases, acute encephalopathy (particularly in children). Long term exposure may result in neurological and hematological effects. Some of the effects on the blood and subtle neurobehavioral changes in children occur at levels so low as to be considered nonthreshold effects. Rat and mouse studies have shown increases in renal tumors, but the human studies have yielded inconclusive results that failed to account for the presence of other potentially carcinogenic materials. The USEPA has classified lead as a B2 carcinogen based on the animal evidence.

Manganese. Manganese is considered to be an essential human nutrient, but exposure to high concentrations can cause lethargy and other neurological effects. Inhalation of manganese results in respiratory symptoms and psychomotor disturbances in occupationally exposed individuals. Manganese is considered in cancer weight-of-evidence Group D.

3.3.2.4 Other Health-Based Criteria

This section contains other health-based criteria for the identified COCs at NSB-NLON. Currently, the only enforceable Federal regulatory standards for exposures to groundwater contamination are the Maximum Contaminant Levels (MCLs). However, MCLs have not been specified for all COCs; therefore regulatory guidelines may be used for comparative purposes to infer health risks. Relevant regulatory guidelines include the AWQC, Maximum Contaminant Level Goals (MCLGs), and Health Advisories. For water, Table 3-4 contains a summary of these other health-based criteria for the COCs and other detected chemicals at NSB-NLON.

Maximum Contaminant Levels (MCLs). MCLs are enforceable standards promulgated under the Safe Drinking Water Act and are designed for the protection of human health. MCLs are based on laboratory or epidemiological studies and apply to drinking water supplies consumed by a minimum of 25 persons. They are designed for prevention of human health effects associated with lifetime exposure (70 years) of an average adult (weighing 70 kg) who consumes 2 liters of water per day, but they also reflect the technical feasibility of removing the contaminant from the water. These enforceable standards also reflect the fraction of toxicant expected to be absorbed by the gastrointestinal tract.

Maximum Contaminant Level Goals (MCLGs). MCLGs are specified as zero for carcinogenic chemicals, based on the assumption of nonthreshold toxicity, and do not consider either the technical or economic feasibility of achieving these goals. Non-zero MCLGs that are below the MCLs are nonenforceable guidelines based entirely on health effects. The MCLs are set as close to the MCLGs as is considered technically and economically feasible.

Ambient Water Quality Criteria (AWQC). AWQC are not enforceable Federal regulatory guidelines, and are of primary utility in the potential for toxic effects in aquatic organisms. They may also be used to identify the potential for human health risks. AWQC consider the acute and chronic toxic effects in both freshwater and saltwater aquatic life, and the adverse human health effects from ingestion of both water (2 liters per day) and aquatic organisms (6.5 grams per day) and from ingestion of organisms alone. This human health risk assessment will focus on the ingestion criteria.

The State of Connecticut has promulgated water quality standards as well. These standards are intended to protect high quality waters from degradation from waste discharges. The groundwater and surface water standards are limited to general criteria such as pH, dissolved oxygen, etc. There are additional water quality criteria for surface waters, similar to the Federal AWQC, which are the focus of this risk assessment.

Health Advisories. Health advisories are guidelines developed by the USEPA Office of Drinking Water for nonregulated contaminants in drinking water. These guidelines are designed to consider both acute and chronic toxic effects in children (assumed to weigh 10 kg) who consume 1 liter of water per day, or in adults (assumed to weigh 70 kg) who consume 2 liters of water per day. Health advisories are generally available for acute (1 day), subchronic (10 days), and chronic (longer term or lifetime) exposure scenarios. These guidelines are designed to consider only threshold effects and, as such, are not used to set acceptable levels of known or probable human carcinogens. Table 3-11 contains a summary of the health advisories for COCs only.

In addition to the Federal and State water criteria described above, the State of Connecticut has adopted remediation standards (CTDEP, January 1996). These regulations are intended to define minimum remediation performance standards. Table 3-5 contains a summary of the proposed Connecticut remediation standards for the COCs, as well as other chemicals detected at NSB-NLON.

Soil remediation standards were developed to protect human health and the environment from direct exposure and to protect groundwater quality from mobile pollutants. The direct exposure criteria include both residential and industrial/commercial scenarios, while the groundwater protection criteria are available for GA/GAA and GB groundwaters.

Groundwater remediation goals for GA or GAA areas are based on the goal of restoration to natural quality, while in GB areas, the goal is to attain or maintain water quality that does not interfere with its designated uses. Groundwater at most sites at NSB-NLON are classified with a GA designation.

Other health based criteria for air are presented in Table 3-6. Threshold Limit Values (TLVs), which are occupational standards set by the American Conference of Governmental Industrial Hygienists (ACGIH), are included. Connecticut remediation standards for indoor air are also presented for residential and industrial land use.

3.3.3 Exposure Assessment

The exposure assessment defines and evaluates the exposures experienced by a receptor population. In order to have an exposure, several factors must be present, first, there must be a source of contamination; second, there must be a mechanism through which a receptor can come into contact with the contaminants in that medium; and third, there must actually (or potentially) be a receptor present at the point of contact.

The exposure assessment presented in this section of the report consists of several sections that characterize the physical site setting and the receptors of concern, identify the potential contaminant migration and exposure pathways, define the contaminant concentrations at the point of exposure, and present the equations used to quantify exposure in terms of contaminant intake (dose). Appendix F.3 of this report contains sample calculations for the exposure assessment. Tables of intakes are not presented in the body of the report, but the calculated values may be seen within the site-specific spreadsheets in Appendices F.4 through F.16.

3.3.3.1 Exposure Setting

This section contains information on the land use and receptor characteristics in the area surrounding NSB-NLON.

Land Use. NSB-NLON is a base command for naval submarine activities in the Atlantic Ocean. The base includes housing for Navy personnel and their families; submarine training facilities; military offices; medical facilities; and facilities used for the maintenance, repair, and overhaul of submarines.

Land use adjacent to the base includes both residential and commercial properties. Residential areas are found along Military Highway, Sleepy Hollow, Long Cove Road, and Pinelock Drive which border the site on the north and extend into the Gales Ferry section of Ledyard. Property along Route 12 east of the site consists of widely-spaced private homes and undeveloped woodlands. Farther south on Route 12, development is mixed commercial and residential, and includes a church, automobile sales and repair facilities, convenience stores, restaurants, and a gas station. Private residences and an automobile service station are located on the south side of Crystal Lake Road, which forms the southern boundary of the base. Additional military housing is located farther south in the Bailey Hill area.

Exposed Populations. NSB-NLON is considered to lie within the boundaries of Groton and Ledyard, which contained a total population of 45,144 in the 1990 census (Atlantic, August 1992). Adjacent communities

to the base include Northwest (located east of Route 12; population 5520 in 1980), Pleasant Valley (located south of the base; population 4374 in 1980), and the base itself (population 4099 in 1980). The community of Gales Ferry in Ledyard bounds the base on the north (population 7802 in 1988). A detailed assessment of the types of activities that currently occur and those that are planned was presented in Appendix E of the Phase I RI Report (Atlantic, August 1992).

3.3.3.2 Conceptual Site Model

This section discusses the general conceptual site model for the sites at NSB-NLON. A conceptual site model facilitates consistent and comprehensive evaluation of the risks to human and ecological health by creating a framework for identifying the paths by which human health may be impacted by contaminants predicted to exist at the source areas. A conceptual site model depicts the relationships between the elements necessary to construct a complete exposure pathway, as follows:

- Sources and potential COCs
- Contaminant release mechanisms
- Contaminant transport pathways
- Exposure mechanisms and exposure routes
- Receptors

Two simple conceptual site models were developed for all source areas to provide the basis for identifying the potential risks to human health and the environment. One model was developed for sites at which the source is at the ground surface (Figure 3-1), and the second model considers sites at which the wastes were initially emplaced (either intentionally or unintentionally) in the subsurface (Figure 3-2). These models consider the current operating conditions of the facilities and the actual or potential receptors who could come into contact with the COCs.

The conceptual site models first consider the sources assumed to be available, either currently or in the future. At these sites, the sources are the wastes disposed of at these facilities or the contaminated soil resulting from onsite activities. Contaminants may be released from these sources by mechanisms such as wind or water erosion, or leaching to the subsurface. Once released from the source, contaminants are transported in media such as air, surface water, or groundwater. Receptors may be exposed either directly or indirectly to contaminants in these media via a variety of mechanisms. The exposure mechanisms considered include routine domestic activities, working outdoors, etc. These exposure mechanisms generally act along one or more exposure routes such as ingestion, inhalation, or direct dermal contact.

The conceptual site models also indicate those exposure routes that are carried through the quantitative risk assessment for each receptor. An objective of the development of the conceptual site model is to focus attention on those pathways that contribute the most to the potential impacts on human health and the environment, and to provide the rationale for screening out other exposure pathways that are minor components of the overall risk.

Sources of Contamination. Each site has its own source of contamination (e.g., wastes disposed in a landfill or materials stored on the ground surface). The following sites are considered to have potential subsurface sources:

- Area A Landfill (Site 2)
- Rubble Fill at Bunker A86 (Site 4)
- Torpedo Shops (Site 7)
- Goss Cove Landfill (Site 8)
- Lower Subbase
- OBDANE (Site 14)
- Spent Acid Storage and Disposal Area (Site 15)

However, it should be noted that these sites may also have localized surface sources of contamination, as well as subsurface sources.

The following sites are considered to have potential surficial sources of contamination:

- CBU Drum Storage Area (Site 1)
- Area A Wetland (Site 2)
- Area A Downstream Watercourses and OBDA (Site 3)
- Area A Weapons Center (Site 20)
- DRMO (Site 6)

The Thames River, which is considered the final site under investigation in this report, receives both surface and subsurface discharges from all of these sites. This site is considered to be unique and not an actual source of contamination. In addition, the Area A Downstream Watercourses (Site 3) receive runoff from several sites. Although pesticide bricks placed at the Downstream Watercourses serve as a potential surficial source of contamination, contamination found at this site may also be attributable to runoff from other surrounding sites.

Ultimately, these sources have the potential to release chemicals to the surface and/or subsurface soil. This soil then serves as a secondary source of contamination.

Contaminant Release and Migration Mechanisms. Chemicals may be released from the sites by a variety of mechanisms including stormwater runoff and subsequent erosion of surface soil, infiltration of soluble chemicals and subsequent migration through the subsurface soil to the water table where they may migrate downgradient, and via wind erosion of surface soil from unpaved areas.

Storms generate runoff, which is directed toward stormwater drainageways. Initially, this water may move across a site as sheet flow, which can entrain loose soil material. This soil is moved from the site as a sediment, and will be deposited where the flow velocity diminishes below that needed to carry a particular grain size. Typically at sites in undeveloped areas, this soil/sediment is deposited in small drainageways, and migrates further downstream with each new storm, which also adds new material.

Soluble chemicals released to the ground surface may also migrate downward through the soil column with infiltrating precipitation. The migration of these chemicals may be somewhat impeded by the chemical's tendency to bind to soil organic material. Eventually, these soluble chemicals may reach the water table. Once in the groundwater, they continue their migration via dispersion and advection in the downgradient direction. Eventually, these chemicals may discharge with the groundwater to a surface water body (lake, stream, or wetland).

Chemicals adsorbed to surface soil may also be released from a site via wind erosion of loose soil material. These particulates are carried downwind and potentially off site if the grain size is small enough and the wind velocity is great enough. Additionally, chemicals may also be released from soil via volatilization.

3.3.3.3 Potential Routes of Exposure

A receptor can come into contact with contaminants in a variety of ways, which are generally the result of interactions between a receptor's behavior or lifestyle and an exposure medium. This assessment defines an exposure route as a stylized description of the behavior that brings a receptor into contact with a contaminated medium.

Air. This pathway is based on the scenario that a receptor is immersed in air that contains suspended particulates and volatile organic vapors originating from the source areas as part of daily living. Subsequent exposure of the receptor occurs upon inhalation of the ambient air.

Initially, a qualitative comparison of maximum detected soil concentrations and USEPA Soil Screening Levels (SSLs) based on intermedia transfer (from soil to air) was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. The SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential receptors under current land use conditions. Exposures to fugitive dust and volatile organic compounds released from soil (surface soil and "all soil") were found to be relatively insignificant based on the qualitative screening, which is summarized in the site specific COC screening tables (Appendix F.4 through F.16). If maximum chemical detections in soil were less than the SSLs, the inhalation exposure pathway was generally not considered for further evaluation. A discussion of the inhalation pathway, as it pertains to each site, is provided in the site-specific exposure assessments in Sections 5.0 through 17.0.

Direct Contact with Soil/Sediment. Receptors may come into direct contact with soil affected by the release of chemicals from the source areas. During the receptor's period of contact, the individual may be exposed via inadvertent ingestion of a small amount of soil or via dermal absorption of certain contaminants from the soil.

Because of the limited guidance available to estimate exposure to soil via dermal contact, a quantitative evaluation of dermal risks is provided for cadmium, dioxins, and PCBs only. Current dermal guidance (USEPA, January 1992) was used to quantitatively assess the potential risks associated with these chemicals. Dermal contact with other chemicals detected in the site soils may or may not result in a significant exposure. In general, PAHs and metals, which were detected frequently in the soil samples and selected as COCs, tend to strongly adhere to organic matter in soil. For these chemicals to be percutaneously absorbed, they must first desorb from soil and diffuse through the skin. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness, temperature, hydration, etc.), volatilization losses, as well as chemical-specific properties.

Direct Contact with Groundwater. It is possible that an excavation (for construction, utility maintenance, etc.) could be deep enough to come into contact with the shallow groundwater. In such an instance, workers could be exposed to the groundwater via dermal contact. In addition, it has been assumed (at the direction of USEPA) that some sites could be developed for future residential land use. Household use of groundwater was evaluated for these sites unless site-specific conditions (e.g., saline water quality near the Thames River) would prevent its use. Under the potential groundwater use scenario, direct dermal contact with groundwater, groundwater ingestion, and inhalation of volatiles could occur during routine exposure.

Exposure to groundwater is evaluated for the adult future resident. Exposures for child residents are presumed to be a lesser magnitude.

Current USEPA Region I guidance (USEPA, August 1995d) was used to assess the human health risks associated with exposure to volatiles in groundwater used for domestic purposes (i.e., showering, bathing, cooking, washing, etc.). This exposure pathway was evaluated in a qualitative fashion by assuming that the dose from inhalation of volatile compounds in potable water is equal to that from direct ingestion. Calculated chemical-specific risks for volatiles organics via ingestion are essentially multiplied by a factor of two to account for ingestion and inhalation exposures.

Direct Contact with Surface Water. Receptors may also come into direct contact with surface water containing chemicals in a dissolved phase. In most cases, this exposure would be of short duration (unless swimming or waterskiing are involved), and individuals may be exposed via dermal contact and/or incidental ingestion. Swimming was considered a potential exposure route for North Lake (evaluated as part of Area A Downstream). Water skiing was considered for the Thames River.

Ingestion of Shellfish. Finally, persons could be exposed to potentially site related contaminants when ingesting shellfish and finfish harvested from the Thames River. It was assumed that local residents consume shellfish and finfish collected in the vicinity of the site. Harvesting of shellfish is actually controlled by commercial interests that move the shellfish to depuration beds in other water bodies prior to sale and combine them with shellfish taken from other water bodies. Therefore, evaluation of shellfish under this exposure scenario is considered to be highly conservative.

3.3.3.4 Potential Receptors

Several potential receptors have been identified under both current and future land use conditions. These receptors were identified by analyzing the interaction of current land use practices and the identified sources of contamination.

Several receptor groups have been defined for this risk assessment. The original receptors identified in the Work Plan (Atlantic, May 1993) have been modified to conform to current guidance, to provide some consistency between sites, to focus the assessment on potentially meaningful exposures, and, in general, to streamline the risk assessment process. These receptors are as follows:

- Full-time employees - Adult military or civilian personnel assigned to work 40 hours/week at a particular facility.
- Construction workers - Adult civilian personnel who may be involved in a short-term, one-time construction project at a site.
- Older child trespassers (from ages 6 to 16) - Older children and teenagers (civilians or family of military personnel) trespassing on or near a site while exploring, playing, etc.
- Adult recreational users - Civilian or military personnel involved in recreational activities such as swimming or waterskiing (North Lake and Thames River). Also includes local residents or military persons who may consume locally harvested shellfish and finfish from the Thames River.
- Child recreational users - Dependent children of military personnel who may swim at North Lake.
- Future residents - Persons (adults and children) residing at a site assuming that the facility is closed and developed for residential purposes.

One or more of these receptor groups are evaluated quantitatively for each of the sites under investigation in this report. Table 3-12 contains a matrix summary of the particular combinations of receptor groups developed with the aid of information presented in the Phase I RI report.

Adult recreational users only are evaluated for ingestion of finfish/shellfish. Exposure and associated risks for adult and child receptors are assumed to be similar (USEPA, May 1989d and September 1989g). Although child recreational users may also be exposed to finfish/shellfish, by convention, the evaluation of the child receptor is not warranted because the risks for this receptor are considered to be adequately addressed by assessing exposure for adult recreational users. Studies indicate that adult receptors typically eat more fish than children. However, overall exposure and potential risks for both receptors are expected to be comparable since differences in body weights for adults and children compensate for the differences in consumption rates.

Future adult and child resident receptors have been included in the baseline human health risk assessment at the direction of the USEPA. These receptors are not potential receptors under current land use and are included only to provide an indication of potential risks if the facility were to close and then developed for residential use. Although enlisted and officer personnel reside at the base under current conditions, the

residential scenario is not applicable for these receptors since (1) they do not reside in the areas of investigation and (2) they are assigned to the base for a relatively short period of time (e.g., three or so years). A future residential scenario is also considered unlikely given the critical nature of the facility with respect to support of the submarine fleet and national defense.

Two variations of each receptor are considered, as per USEPA Region I guidance. The first is identified as a central tendency exposure (CTE) receptor, which is developed using both regional guidance (USEPA Region I, August 1994m) and professional judgment regarding site-specific conditions. The second class of receptor is called the reasonable maximum exposure (RME), and was developed as per USEPA guidance (USEPA, December 1989f; USEPA Region I, August 1994m).

3.3.3.5 Exposure Pathways

An exposure pathway is considered to be complete if it is determined that there is (1) a source or release of chemicals from a source; (2) an exposure point where contact can occur; and (3) an exposure route by which contaminants are taken into the human body. This section summarizes the potentially complete exposure pathways that are quantitatively evaluated in the risk assessment and provides the rationale for those pathways that are not. Table 3-13 presents a summary of the potentially complete and incomplete exposure pathways and receptors.

3.3.3.6 Quantification of Exposure

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of USEPA guidance documents which are cited in the specific intake estimation sections that follow.

Exposures are dependent on the predicted concentrations of chemicals in environmental media and local land use practices, and both are subject to change over time. This results in a large number of possible combinations of receptors, media, exposure pathways, and concentrations. As mentioned previously, Table 3-13 presented a summary of the exposure pathways to be evaluated in the quantitative risk assessment. Some of these scenarios (such as occupational, trespassing, and recreational scenarios) may be applicable under both current and future land use conditions.

Exposure model parameters are presented in Tables 3-14, 3-15, and 3-16 for trespassers and potential future residents, workers, and recreational users, respectively. The parameters are based on those presented in the Work Plan (Atlantic, May 1993), but have been modified to be in conformance with current USEPA guidance. All parameters are referenced in footnotes on each table. These parameters are used in the equations presented in this section, along with the exposure point concentrations presented in the site-specific sections, to calculate intakes, which will be used to determine risks. Individual chemical intakes for each receptor/exposure route combination are presented in the spreadsheets in Appendices F.4 through F.16.

Air Exposure Via Inhalation. The amount of a chemical a receptor takes in as a result of respiration is determined using the concentration of the contaminant in air. Intakes of both particulates and vapors/gases are calculated using the same equation, as follows (USEPA, December 1989f):

$$Intake_{ai} = (C_{ai})(IR)(ET)(EF)(ED)/(BW)(AT)$$

where:

$Intake_{ai}$	=	intake of chemical "i" from air (PM10 or vapor) inhalation (mg/kg/day)
C_{ai}	=	concentration of chemical "i" in PM10 fraction or air (mg/m ³)
IR	=	inhalation rate (m ³ /hr)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED*365 days/yr;
		for carcinogens, AT = 70yr*365 days/yr

The concentrations of chemicals in air were developed using PM10 modeling completed in the Phase I RI (Atlantic, August 1992). The air concentration term (C_{ai}) is calculated by multiplying the PM10 fraction in air by the chemical concentration in the soil. The following conversion factors were used in the Phase I RI (Atlantic, August 1992):

- For activities involving construction - 9E-8 mg/m³.
- For onsite exposures, no soil disturbance - 1.8E-8 mg/m³.

Exposure times range from two hours/day for the CTE older child trespasser to 24 hours/day for RME potential future residents. Exposure frequencies range from 52 days/year for a CTE trespasser to 350 days/year for the RME potential future resident. All exposure factors for the identified receptor groups are outlined in Tables 3-14 through 3-16.

As mentioned previously, the inhalation exposure pathway is not evaluated for all sites. A qualitative evaluation of exposure to air only is provided for those sites where exposure is expected to be minimal (i.e., where maximum soil detections were less than USEPA SSLs for transfers from soil to air).

Incidental Ingestion of Soil/Sediment. The estimation of intake of contaminants in soil (and sediment) is determined using the predicted concentration of a contaminant in the location of interest. This pathway is evaluated for both child and adult receptors. Age-adjusted ingestion factors are used to estimate intakes for future residents because of the higher ingestion rate experienced by small children. In general, intakes associated with soil ingestion are calculated using the following equation:

$$Intake_{si} = (C_{si})(IR)(FI)(EF)(ED)(CF)/(BW)(AT)$$

where:

$Intake_{si}$	=	intake of contaminant "i" from soil or sediment (mg/kg/day)
C_{si}	=	concentration of contaminant "i" in soil or sediment (mg/kg)
IR	=	ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (decimal fraction)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, $AT = ED \times 365$ days/yr;
		for carcinogens, $AT = 70 \text{ yr} \times 365$ days/yr

For adults not involved in construction activities and older children, ingestion rates are considered to range from 50 mg/day (adults under CTE conditions) to 200 mg/day (potential future child residents for the RME). Ingestion rates of 480 mg/day (RME) (USEPA, March 25, 1991e) and 240 mg/day (CTE) are considered for construction personnel. Exposure frequencies range from 1 day/year for the CTE utility worker to 250 days/year for the RME full-time employee. Values of 1.0 for the RME and 0.5 for the CTE are used for the fraction of soil/sediment from the contaminated source ingested by a potential receptor.

Dermal Contact with Soil/Sediment. The estimation of intake of a contaminant in soil (and sediment) via absorption through the skin is determined using the predicted concentration in the soil at the location of concern. Evaluation of the dermal absorption pathway is performed for both child and adult receptors. As with soil ingestion, age-adjusted contact rates are employed for potential future residents. Dermal absorption from potentially contaminated areas is calculated using the following equation:

$$Intake_{si} = (C_{si})(SA)(AF)(ABS)(Fd)(CF)(EF)(ED) / (BW)(AT)$$

where: $Intake_{si}$ = amount of chemical "i" absorbed during contact with soil/sediment (mg/kg/day)

C_{si} = concentration of chemical "i" in soil/sediment (mg/kg)

SA = skin surface area available for contact (cm²/day)

AF = skin adherence factor (mg/cm²)

ABS = absorption factor (decimal fraction)

Fd = Fraction available for contact from contaminated source (decimal fraction)

CF = conversion factor (10⁻⁶ kg/mg)

EF = exposure frequency (days/yr)

ED = exposure duration (yr)

BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED*365 days/yr;
for carcinogens, AT = 70 yr*365 days/yr

Dermal contact with soil by potential receptors is assumed to occur at the same exposure frequency as soil ingestion. Exposed surface areas of 19 percent of the total body surface area (to account for forearms, head, and hands) for the adults and 30 percent of the total body surface area (to account for forearms, head, hands, and feet) for the children were selected based on default clothing scenarios expressed in the USEPA dermal exposure guidance (USEPA, August 1992h). Soil adherence factors were selected from the published range of 0.2 to 1.0 mg/cm² (USEPA, January 1992d). Values of 1.0 (RME) and 0.5 (CTE) were used for the fraction of soil/sediment available for contact from the contaminated source.

As discussed previously, intakes for dermal contact with soil and sediment were quantified for cadmium, PCBs, and dioxins only because of limited guidance. Absorption factors presented in current dermal guidance (USEPA, January 1992d) were used to assess exposure to these chemicals.

Dermal Contact with Groundwater/Surface Water. Because the groundwater and surface waters at the base are not used for potable supplies, only limited exposure scenarios are considered under current site conditions. However, potential future residents are evaluated for future land use at some sites. These receptors are assumed to use groundwater for domestic purposes (i.e., bathing, showering, washing dishes). This scenario assumes that a residential development is constructed on the site and potable wells are installed. It is also possible under future land use conditions that deep excavations at the base for activities such as utility maintenance and construction could result in a dermal exposure to the shallow groundwater (that contained in the overburden). Dermal contact with surface waters may also occur while receptors are involved in certain activities, such as swimming in North Lake, exploring in areas such as the Area A Wetland, or waterskiing in the Thames River.

The following equation will be used to assess exposures resulting from dermal contact with water (USEPA, January 1992d):

$$DAD_{wi} = (DA_{event})(EV)(ED)(EF)(A) / (BW)(AT)$$

where: DAD_{wi} = dermally absorbed dose of chemical "i" from water (mg/kg/day)
 DA_{event} = absorbed dose per event (mg/cm²-event)
 EV = event frequency (events/day)
 ED = exposure duration (yr)
 EF = exposure frequency (days/yr)
 A = skin surface area available for contact (cm²)
 BW = body weight (kg)
 AT = averaging time (days);
 for noncarcinogens, AT = ED*365 days/yr;
 for carcinogens, AT = 70yr*365 days/yr

The absorbed dose per event (DA_{event}) is estimated using a nonsteady-state approach for organic compounds and a more traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^*, \text{ then: } DA_{event} = (2 K_p) (C_{wi}) (CF) \left[\frac{\sqrt{6 \tau t_{event}}}{\pi} \right]$$

$$\text{If } t_{event} > t^*, \text{ then: } DA_{event} = (K_p)(C_{wi})(CF) \left[\frac{t_{event}}{1+B} + 2 \tau \left[\frac{1+3B}{1+B} \right] \right]$$

where: t_{event} = duration of event (hr/event)
 t^* = time it takes to reach steady-state conditions (hr)
 K_p = permeability coefficient from water through skin (cm/hr)
 C_{wi} = concentration of chemical "i" in water (mg/L)
 T = lag time (hr)
 π = constant (unitless; equal to 3.141592654)
 CF = conversion factor (10^{-3} L/cm³)
 B = partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters (t_{event} , t^* , K_p , T , and B) were obtained from the current dermal guidance. If no published values are available for a particular organic compound, they were calculated using equations provided in the cited guidance. Details regarding the procedures used to derive the constants, as well as sample calculations, are provided in Appendix F.3.

The following nonsteady-state equation is used to estimate DA_{event} for inorganics:

$$DA_{\text{event}} = (K_p) (C_{wi}) (t_{\text{event}})$$

In general, the recommended default value of 1E-3 was used for inorganic constituents.

Potential future residents are assumed to be exposed to groundwater 350 days/year for the RME and 234 days/year for the CTE at exposure durations ranging from 9 years to 30 years. Whole body contact is assumed for future residents. Groundwater exposure times for adult construction workers are 8 hours/day for 120 days/year for the RME and 80 days/year for the CTE. The exposure duration for this receptor was set at 1 year. Construction workers exposed to groundwater are assumed to be exposed only on their forearms and hands, for a total area of 3800 cm². For trespassers, surface water dermal exposures are evaluated as 2 to 4 hours per day for 52 to 120 days/year. Receptors involved in recreational activities (swimming/waterskiing) are assumed to experience whole body exposure, for a total surface area of 20000 cm² for adults and 6980 cm² for small children. Children are assumed to swim in North Lake at a frequency of 55 days/year (11 weeks/year, 5 days/week), while adult swimmers are assumed to be exposed for 22 days/year. Waterskiing exposure frequencies for the adult receptor were set at 16 days/year (RME) and 8 days/year (CTE).

Incidental Ingestion of Groundwater/Surface Water. Potential future residents (adults and children) may be exposed to groundwater via direct ingestion. Direct contact with surface waters while swimming or

exploring could also result in the inadvertent ingestion of small amounts of water. Trespassers and small children swimming at North Lake are the most likely receptors for incidental ingestion of surface water. Their exposures are evaluated using the following equations (USEPA, December 1989f):

$$Intake_{wi} = (C_{wi})(IR)(EF)(ED) / (BW)(AT) \quad \text{for groundwater}$$

$$Intake_{wi} = (C_{wi})(CR)(ET)(EF)(ED) / (BW)(AT) \quad \text{for surface water}$$

where: $Intake_{wi}$ = intake of chemical "i" from water (mg/kg/day)
 C_{wi} = concentration of chemical "i" in water (mg/L)
 IR = ingestion rate for groundwater (L/day)
 CR = contact rate for surface water (L/hr)
 ET = exposure time for surface water (hr/day)
 EF = exposure frequency (days/yr)
 ED = exposure duration (yr)
 BW = body weight (kg)
 AT = averaging time (days);
 for noncarcinogens, $AT = ED \times 365 \text{ days/yr}$;
 for carcinogens, $AT = 70 \text{ yr} \times 365 \text{ days/yr}$

Exposure times, frequencies, and durations are the same as described above for dermal contact. Ingestion rates for potential future residents are 1.4 L/day (CTE) and 2 L/day (RME). The ingestion rate for child recreational users and trespassers exposed to surface water was set at 0.05 L/hr (USEPA, Region I, June 1989e).

Inhalation of Volatiles in Groundwater. As discussed previously, exposure to volatiles in groundwater used for domestic purposes is addressed by assuming that the dose from inhalation is equal to the estimated dose for ingestion of volatiles. This approach was used at the direction of the USEPA (August 1995d).

Ingestion of Shellfish/Finfish. Indirect chemical exposure may also occur via the ingestion of shellfish or finfish harvested from the Thames River. It is possible, though unlikely, that local residents could be exposed to shellfish from this area, although all harvesting is supposedly controlled by commercial concerns which remove the shellfish to offsite depuration beds, where they are combined with shellfish from other areas, prior to sale. The following model will be used to assess potential exposures resulting from ingestion of shellfish and finfish from the Thames River (USEPA, December 1989f):

$$Intake_{fi} = (C_{fi})(IR)(EF)(ED) / (BW)(AT)$$

where: $Intake_{fi}$ = intake of chemical "i" from shellfish/finfish (mg/kg/day)
 C_{fi} = concentration of chemical "i" in shellfish/finfish (mg/kg)
 IR = ingestion rate (kg/day)
 EF = exposure frequency (days/yr)
 ED = exposure duration (yr)
 BW = body weight (kg)
 AT = averaging time (days);
for noncarcinogens, $AT = ED * 365$ days/yr;
for carcinogens, $AT = 70 \text{ yr} * 365$ days/yr

The following ingestion rates were used:

- for shellfish, 0.055 kg/day for the RME and 0.003 kg/day for the CTE
- for finfish, 0.054 kg/day for the RME and 0.0095 kg/day for the CTE

Actual shellfish concentrations were available for oysters and clams, which are the only two species of potential commercial interest in the river. Finfish tissue concentrations were estimated using surface water data and chemical-specific bioconcentration factors. Receptors are assumed to be exposed for 350 days/year for the RME and 234 days/year for the CTE.

3.3.3.7 Exposure to Lead

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters for this chemical. Exposure to lead was added using the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead, version 0.99D (USEPA, February 1994). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure.

Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood lead levels. The threshold for toxic effects from this chemical is believed to be in the range of 10 $\mu\text{g/dL}$ to 15 $\mu\text{g/dL}$. Blood lead levels greater than 10 $\mu\text{g/dL}$ are considered to be a "concern".

In general, the IEUBK Model for lead was used to address exposure to lead when detected groundwater and surface water concentrations exceed the 15 $\mu\text{g/L}$ Federal Action Level promulgated under the Safe Drinking Water Act and when detected soil and sediment concentrations exceeded the OSWER soil screening level of 400 mg/kg for residential land use (USEPA, July 14, 1994i). Exposure concentrations, as well as default parameters for some input parameters, were used. Exposures to this analyte are discussed in the site-specific sections (Sections 5.0 through 17.0). The input parameters used and the results of the model, estimated blood lead levels and probability density histograms, are presented in the site-specific appendices.

3.3.4 Risk Characterization

This section provides a characterization of the potential human health risks associated with the potential exposure to COCs at NSB-NLON. Section 3.3.4.1 outlines the methods used to estimate the type and magnitude of health risks, and site-specific sections in Chapters 5.0 through 17.0 present the results for the current and potential future land use conditions for the individual sites. Section 3.3.5 contains a discussion of the uncertainties associated with all aspects of the process.

3.3.4.1 Risk Characterization Methodology

Potential human health risks resulting from exposure to COCs are estimated using algorithms established by the USEPA. The methods described by the USEPA are protective of human health and are likely to overestimate (rather than underestimate) risk. The methodology uses specific algorithms to calculate risk as a function of chemical concentration, human exposure parameters, and toxicity.

Risks from hazardous chemicals are calculated for either carcinogenic or noncarcinogenic effects. Some carcinogenic chemicals may also exhibit noncarcinogenic effects. Potential impacts are then characterized for both types of health effects.

Chemical Carcinogens. Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. At low doses, the incremental lifetime cancer risk (ILCR) is determined as follows (USEPA, December 1989f):

$$ILCR_i = (Intake_i)(CSF_i)$$

where: $ILCR_i$ = Incremental Lifetime Cancer Risk for chemical "i", expressed as a unitless probability
 $Intake_i$ = Intake of chemical "i" (mg/kg/day)
 CSF_i = Cancer Slope Factor of chemical "i" (mg/kg/day)⁻¹

Risks below 1E-6 (1/1E+6, or a risk less than 1 in 1 million) are generally considered to be acceptable by the USEPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable by the agency.

When carcinogenic risks exceed 1E-2 using the above methodology, the USEPA (December 1989f) specifies that the one-hit model be used, as follows:

$$ILCR_i = 1 - \exp(-Intake_i)(CSF_i)$$

Risks are estimated for all carcinogenic compounds regardless of the class designation (A, B, or C).

Noncarcinogens. The hazards associated with the effects of noncarcinogenic chemicals are evaluated by comparing an exposure level or intake to a Reference Dose (RfD). The ratio of the intake to the RfD is called the Hazard Quotient (HQ) and is defined as follows (USEPA, December 1989f):

$$HQ_i = \frac{Intake}{RfD_i}$$

where: HQ_i = Hazard Quotient for chemical "i" (unitless)
 $Intake_i$ = Intake of chemical "i" (mg/kg/day)
 RfD_i = Reference Dose of chemical "i" (mg/kg/day)

If the ratio of the intake to the RfD exceeds unity, there exists a potential for noncarcinogenic (toxic) effects to occur. A Hazard Index (HI) is generated by summing the individual HQs for all the COCs. If the value of the HI exceeds unity, there is a potential for noncarcinogenic health effects associated with that particular chemical mixture, and therefore it is necessary to segregate the HQs by target organ effects. The HQ should not be construed as a probability in the manner of the ILCR, but rather a numerical indicator of the extent to which a predicted intake exceeds or is less than an RfD.

3.3.5 Uncertainties Analysis

There is uncertainty associated with all aspects of the baseline human health risk assessment presented in the preceding sections. This section will present a summary of these uncertainties, with a discussion of how they may affect the final risk numbers discussed in Sections 5.0 through 17.0.

There is uncertainty associated with all steps of the risk assessment process. Uncertainty in the selection of COCs is associated with the current status of the predictive data bases and the procedures used to include or exclude constituents as chemicals of concern. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route, the methods used and the assumptions made to determine exposure point concentrations, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing data to support dose-response relationships, and the weight-of-evidence used for determining the carcinogenicity of chemicals of concern. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

While there are various sources of uncertainty, as described above, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions were made so that the final calculated risks would be overestimated because of the safety factors built into the assumptions. Thus, the resultant uncertainty in the numerical risk assessments is in how much lower the actual risks are.

Generally, risk assessments carry two types of uncertainty -- measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward overpredicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point-of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are below an "acceptable" risk level (i.e., $1E-6$), the interpretation of no significant risk is straightforward. However, when risks calculated using a high degree of uncertainty are above an "acceptable" risk level (i.e., $1E-4$), a conclusion can be difficult unless uncertainty is considered.

Recent USEPA guidance on risk assessment (USEPA, February 26, 1992e; USEPA Region I, August 1994m) requires risk assessors to use exposure and toxicity assumptions from the "high end" and the "central tendency" of their distributions. These values correspond to the RME and central tendency (CT) scenarios.

3.3.5.1 Uncertainty in Selection of Chemicals of Concern

There is a minor amount of uncertainty associated with the final risk values based on the selection of COCs to be used in the quantitative risk assessment. However, the use of predetermined screening values based on conservative land use scenarios (i.e., residential land use for soil and sediment, and ingestion/inhalation for groundwater/surface water) in combination with the reduction of the values for carcinogens to correspond to a $1E-6$ cancer risk should ensure that the most significant contributors to risk from a site are evaluated. The elimination of chemicals that are present at concentrations that correspond to a less than a $1E-6$ cancer risk and less than a 0.1 HI should not affect the final conclusions regarding contaminants that could cause a potential health concern.

There are additional chemicals (e.g., benzo(g,h,i)perylene and phenanthrene) for which there are no available health criteria and for which no risk-based COC screening criteria could be developed. These compounds are not, therefore, included as COCs for this assessment. The elimination of these particular compounds

from the quantitative risk assessment should not change the conclusions of the report. In many cases, chemicals from the same or similar chemical class are included as COCs. Given that CERCLA type risk assessments are designed to be conservative (i.e., they tend to over predict rather than under predict risk), it is unlikely that the exclusion of these chemicals from the quantitative risk analysis will result in a significant underestimation of risk.

3.3.5.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises for the methods used to calculate exposure point concentrations, determination of land use conditions, the selection of receptors, and the selection of exposure parameters. Each of these is discussed below.

Determination of Land Use. The current land use patterns were well established by Atlantic Environmental, Inc., during the Phase I RI. Detailed interviews with base personnel were used to establish the potentially exposed populations and the activities that could bring them into contact with contaminated media. In addition, planned construction projects were identified.

One issue associated with land use that contains a high degree of uncertainty is the potential conversion of the base (particularly the sites under consideration in the RI) to residential uses at some time in the future. This scenario is considered to be highly unlikely given the dispersed population patterns currently surrounding the base and the heavily industrialized nature of the facility at the current time. These factors, in addition to the critical nature of the facility with respect to support for the submarine fleet, make a future industrial land use scenario much more likely, at least for the foreseeable future.

Calculation of Exposure Point Concentrations. For most media at most sites, less than ten samples were available. This makes the estimation of the upper 95 percent confidence limit on the mean highly uncertain, and therefore, the average and maximum detected chemical concentrations were used to assess risks. As a result, the estimations of risk for the RME, where maxima were used as exposure concentrations, are most likely to be overstated because it is unlikely that potential receptors would be exposed to the maximum concentration over the entire exposure period.

For some sites, the risk evaluation focused on one or more smaller areas of concern. These boundaries are somewhat artificial, and originated as investigations of something perhaps like a tank or are simply gross geographical boundaries. Exposures may or may not occur in these particular areas, and therefore risks could be under- or overestimated.

Exposure Routes and Receptor Identification. Based on the work performed by Atlantic Environmental Services, Inc., exposure routes and receptor groups were fairly well-defined. In this report, an attempt was made to simplify the various groups identified, as well as to determine a single set of exposure parameters to apply to each group. This may either under- or over-estimate the risks, with the final result dependent on how well the receptors were defined.

Selection of Exposure Parameters. Each exposure factor selected for use in this risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, the USEPA guidelines on the RME receptor were used, which generally consist of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Generally, the uncertainty can be assessed quantitatively for a number of assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often the data base used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (i.e., dermal absorption of organic chemicals from soil), there is greater uncertainty. However, there are often sufficient data to estimate these parameters with low uncertainty.

Many of the quantities used to calculate exposures and risks in this report are selected from a distribution of possible values. For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions, but does not indicate what a more average or typical exposure might be, or what risk range might be expected for individuals in the exposed population. To address these issues, the USEPA has suggested the use of the CTE receptor, whose intake variables are set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Many of the parameters were estimated using professional judgment, although USEPA Region I provides some default parameters (USEPA Region I, August 1994m).

An additional source of uncertainty associated with the exposure assessment of the baseline human health risk assessment is the presence of the hospital at the base, which is located near Tautog Avenue. Sick or

ailing individuals represent a subpopulation of potential concern since they may experience an increased risk because of increased sensitivity to chemical exposure. Most of the sites under investigation in this RI Report are not within close proximity to the hospital. Therefore, the degree of uncertainty associated with this aspect of the exposure analysis is not expected to be great.

3.3.5.3 Uncertainty in the Toxicological Evaluation

Uncertainty associated with the toxicity assessment is associated with hazard assessment and dose-response evaluations for the chemicals of concern. The hazard assessment deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using the USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may also manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of noncancer effects, however, positive animal data suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose-related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a slope factor for the carcinogenic assessment and derivation of an RfD or Reference Concentration (RfC) for the noncarcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the COC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the

data base. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. There is evidence to suggest, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic (Williams and Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For noncancer effects, additional uncertainty factors may be applied in the derivation of the RfD or RfC to mitigate poor quality of the key study or gaps in the data base. Additional uncertainty for noncancer effects arises from the use of an effect level in the estimation of an RfD or RfC, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD or RfC for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

Class C carcinogens are classified as possible human carcinogens because the evidence for their carcinogenicity in animals is limited. The inclusion of these compounds in the estimation of total carcinogenic risk adds to the uncertainty of the final risk numbers by potentially overestimating the human health effects.

Another source of uncertainty in this risk assessment is the lack of cancer slope factors for compounds identified by the USEPA as possible human carcinogens (Class C compounds). The only Class C compounds identified as COCs at this site are 2-methylphenol, 1,1,2,2-tetrachloroethane, and 1,1-dichloroethene. It is unlikely that the evaluation of these particular compounds as potential carcinogens would change the conclusions of the carcinogenic risk evaluations.

Another potential source of uncertainty in the toxicity assessment is the extrapolation of Reference Concentrations to Reference Doses without use of an inhalation absorption factor. Typically, CERCLA risk assessments require the conversion of an air concentration to an internal dose, which is accomplished by

using a body weight of 70 kg and an inhalation rate of 20 m³/day. So while this conversion is not thought to add significantly to the uncertainty in a risk assessment, it is not recommended unless the primary literature is consulted first. Since all inhalation RfDs (RfCs) were obtained from USEPA sources, the uncertainty associated with the conversions are expected to be minimal.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

Uncertainty also arises in the dose-response assessment for values derived for several principal chemicals of concern by using studies with limitations. For example, Class B2 PAHs for which no toxicity data are available are evaluated using benzo(a)pyrene toxicity data with estimated orders of potential potency for the average and RME receptors. This may either underestimate or overestimate the carcinogenic risks associated with PAHs.

The carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the USEPA has proposed an oral unit risk factor that was used for all oral and dermal exposures to arsenic at this site. Since arsenic is a major risk driver, the risks may be overstated.

Some uncertainty is associated with the evaluation of chromium, which was assumed to be present in its hexavalent state. Since hexavalent chromium is considered to be more toxic than the trivalent state, which essentially more common, risks for this chemical are probably overestimated to some degree.

3.3.5.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple compounds from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COCs. Therefore, this uncertainty

cannot be discussed for its impact on the risk assessment, since it may either underestimate or overestimate potential human health risk.

3.4 ECOLOGICAL RISK ASSESSMENT PROCEDURES

The objective of the NSB-NLON ecological risk assessment is to characterize the current impacts of site activities on aquatic and terrestrial biota and on habitats that may support ecological receptors. The results of the ecological risk assessment, as well as the human health risk assessment, will serve as a partial basis for determining whether further action is required at any of the sites under investigation. This effort represents a "Baseline Ecological Risk Assessment" (BERA), which evaluates potential risks to ecological receptors under existing site contamination conditions, assuming that no remediation is to be conducted (i.e., the "no action" alternative). The BERA only considers impacts associated with past disposal practices or releases of chemical contaminants at the site; permitted or regulated chemical releases occurring as a result of current operations are not addressed.

A number of environmental investigations have been conducted at the facility and several have addressed potential impacts to ecological receptors. However, these investigations have generally focused on individual sites on the NSB-NLON, and have not addressed ecological risks from a base-wide perspective. The methods outlined in this section were used to prepare ecological risk assessments for each site that integrates information and results presented in previous investigations (e.g., Phase I RI, FFS) with the results of investigations conducted in the Phase II RI supplemental ecological investigations. The incorporation and evaluation of all available ecological information in one comprehensive document will provide the risk manager with a better understanding of potential ecological risks and the relationship between sources of contamination and potentially impacted receptors.

The problem formulation, the first step in an ecological risk assessment is described in Section 3.4.1. The methodology used to determine which of the contaminants detected on the NSB-NLON represent a potential risk to ecological receptors is presented in Section 3.4.2. The Basewide conceptual model is discussed in Section 3.4.3. The Exposure Assessment (Section 3.4.4) defines and evaluates exposure of receptor organisms to contaminants. Section 3.4.5 provides the Risk Characterization Methodology. This section defines and evolves exposure of receptor organisms to contaminants. General uncertainties associated with the risk assessment process are discussed in Section 3.4.6.

3.4.1 Problem Formulation

The problem formulation step represents the first phase of an ecological risk assessment and establishes the goals, breadth, and focus of the assessment (USEPA, 1992). Problem formulation involves a series of interrelated steps designed to identify potential stressors, pathways and ecological effects. Ecological endpoints appropriate for the site are then derived, and a conceptual model is developed for the site. The conceptual model provides an indication of how ecological receptors might come in contact with chemicals in various media.

The following information is generally considered in the problem formulation step (USEPA, 1994):

- Site description
- Ecosystems and species of concern
- Methods used to identify COCs
- Ecological endpoints

A description of the NSB-NLON and local ecology is contained in Sections 1.2.4 and 4.8. In addition, site-specific descriptions are provided in Sections 5.0 through 17.0. Ecosystems and species of concern are also discussed in Section 4.8 and in Sections 5.0 through 17.0. Methods used to identify COCs and ecological endpoints used in this assessment are described in Sections 3.4.2 and 3.4.3.4, respectively. A base-wide conceptual site model (CSM) is developed in Section 3.4.3. Based on the CSM, complete exposure pathways are identified (Section 3.4.3.3) and ecological endpoints determined (Section 3.4.3.4).

3.4.2 Methods Used to Identify Chemicals of Concern

This section summarizes the methodology used to determine which of the contaminants detected on the NSB-NLON represent a potential risk to ecological receptors. Media-specific COCs were selected by comparing conservative, media-specific exposure point concentrations (e.g., maximum concentration of copper detected in the Upper Pond surface water samples) to criteria or benchmark values that are protective of ecological receptors.

3.4.2.1 Surface Water

Surface water COCs were identified by comparing conservative, representative concentrations of contaminants (either the maximum concentration or the UCL) present in samples collected from onsite

freshwater bodies (e.g., the Area A Downstream Watercourses and OBDA) and from the Thames River to NSB-NLON background concentrations (inorganics only) and to values protective of aquatic biota. The process used to derive benchmark values and to select surface water COCs is summarized below by freshwater systems, Thames River and Goss Cove, and drinking water.

Freshwater Systems

As discussed in Section 2.0, surface water samples were collected from various locations on the NSB-NLON (e.g., the Area A Downstream Watercourses and OBDA) and from several off-site reference locations (Figure 3-3). The Area A Downstream Watercourses and OBDA consist of four small, ephemeral streams (Streams 1 - 4) and three small ponds (the Upper, Lower, and OBDA Ponds). The offsite reference water bodies were specifically selected based on their physical similarity to the waterbodies of the Area A Downstream Watercourses and OBDA. Niantic Pond (Figure 3-4) served as the reference pond for Lower Pond while the reference pond for the OBDA and Upper Ponds was a small pond located at Pequot Woods (Figure 3-5). Sampling location 28 on Fishtown Brook represented the reference location for Streams 3 and 4 while Fishtown Brook sampling location 29 served as the reference station for Streams 1 and 3 (see Section 2.0). Although specifically selected to serve as reference locations for systems present in the Area A Downstream Watercourses and OBDA, these reference locations were also used to identify inorganic COCs present in surface water collected from other locations on the NSB-NLON. Pequot Woods Pond was used as the reference location for the Area A Wetland and Fishtown Brook Station 29 served as the reference location for samples collected from the Area A Weapons Center drainage ditches.

For this assessment, surface water COCs were identified by first comparing representative concentrations of inorganic analytes detected in the various onsite waterbodies to concentrations of inorganic constituents measured in their respective reference locations. All inorganics present in excess of reference sample concentrations and all organic compounds were then compared to benchmark values protective of aquatic life.

The benchmark values preferentially used in this BERA to identify surface water COCs were primarily freshwater chronic AWQC developed by CTDEP and USEPA. Exposures of NSB-NLON aquatic receptors to COCs are assumed to be primarily chronic (long-term), usually at sublethal concentrations; CAWQC are developed to protect sensitive aquatic species from exposures to chronic, sublethal contaminant concentrations. These CAWQC therefore serve as conservative and appropriate values for identifying surface water COCs.

Study area-specific (e.g., Upper Pond, Pequot Woods, etc.) surface water hardness values (mg/L CaCO_3) were used to calculate site-specific chronic AWQC for those metals whose toxicity in freshwater is hardness-dependent.

CAWQC were not uniformly available for all potential COCs. When a CAWQC had not been developed for a specific analyte, it was necessary to identify surrogate chronic benchmark values. The acute toxicity database for aquatic receptors is much larger than that pertaining to chronic toxic effects. This database served as a major source of data from which surrogate benchmark values were derived. Acute toxicity is generally expressed as the " LC_{50} " or the aqueous concentration of a contaminant lethal to 50 percent of the test population. For this BERA, chronic benchmark values were derived by dividing available LC_{50} values by 100.

The use of $\text{LC}_{50}/100$ is based on the assumption that this ratio provides a reasonable and adequate level of protection for sensitive, untested species. This ratio has been employed by the Office of Pesticide Programs of the USEPA to protect sensitive wildlife species (Urban and Cook, 1986). In the process of developing water quality criteria in 1972, the National Research Council suggested that the LC_{50} value be divided by factors of 10 or 100, depending on persistence and potential to bioaccumulate (National Research Council, 1972). More recently, examination of the results of acute and chronic toxicity tests performed on National Pollutant Discharge Elimination System (NPDES) effluents has indicated that the ratios of acute to chronic toxicity values seldom exceed 10 (i.e., $\text{LC}_{50}/10 = \text{chronic value}$) and ratios above 20 ($\text{LC}_{50}/20$) have not been observed (USEPA, 1991). The use of the $\text{LC}_{50}/100$ value, therefore, provides a conservative estimate of chronic benchmark values.

In a number of instances, Lowest Observable Effects Concentrations (LOEC) generated during chronic toxicity testing, rather than LC_{50} values, were available. These values were converted to surrogate chronic benchmark values by dividing by a factor of 10. The use of $\text{LOEC}/10$ to derive chronic benchmark values has been extensively examined in aquatic toxicology (e.g., derivation of no observable effects values from chronic toxicity test data). This method has been found to provide a conservative estimate of concentrations protective of sensitive aquatic species (Calabrese and Baldwin, 1993).

Frequently, neither CAWQC nor toxicity data were available for potential surface water COCs. This was particularly true for organic compounds. In these instances, a computer program developed by USEPA (ECOSAR; USEPA, 1992c) was used to derive benchmark values for these contaminants. This program includes a series of models based on quantitative structure-activity relationships (QSAR) that permit the prediction of toxicity endpoints for a chemical based on the known toxicity of related chemicals to similar

organisms. Chemical-specific parameters used predict toxicological endpoints included log K_{ow} , melting point, molecular weight, and the chemical's solubility in water (USEPA, 1992c).

In addition to comparisons to CAWQC, maximum and average detected contaminant concentrations were also compared to acute benchmarks when they exceeded CAWQC. For freshwater, CTDEP acute screening levels (Water Quality Standards) were preferentially used. When they were not available, acute AWQC were used.

Several of the inorganic chemicals detected in surface water samples collected from onsite locations were present in concentrations exceeding NSB-NLON background concentrations (e.g., calcium, magnesium, potassium, sodium). These chemicals are considered to be nontoxic and were eliminated from further consideration.

As described above, all analytes present in excess of background concentrations (inorganics only) and in excess of benchmark values were regarded as freshwater COCs. Benchmark values used to identify freshwater COCs are summarized in Table 3-17.

Thames River and Goss Cove

Water samples were collected from the Thames River and Goss Cove in 1993. As noted in Section 2.7, samples were collected from the surface of the river as well as near the river's bottom. As previously discussed, this river is a tidally-influenced, estuarine river with water quality characteristics typical of marine systems (i.e., salinity > 10 ppt; Appendix G). Depending on the point in the tidal cycle, the river upstream from NSB-NLON may be influenced by the incoming tide or by freshwater moving downstream from the river's upper reaches. Therefore, because of the tidal influence, no true "upstream", reference station exists for the sampling stations on the Thames River. In order to distinguish concentrations of inorganic analytes attributable to naturally occurring conditions (versus those that may be attributable with activities on the NSB-NLON), average concentrations of inorganic analytes reported in seawater (Hem, 1985) were selected to represent background conditions for the Thames River and Goss Cove (Table 3-18).

As was the case for the onsite freshwater systems, inorganic surface water COCs were identified by comparing representative concentrations of inorganics to average concentrations of inorganics. All inorganics present in excess of seawater concentrations and all organic compounds were then compared to water quality criteria or benchmark values protective of marine aquatic life. As defined in 40 CFR 131, saltwater criteria are applicable for water bodies with salinity values greater than 10 ppt such as the Thames

River and Goss Cove (Appendix G). Like the freshwater systems, CAWQC for marine systems were preferentially selected to identify potential marine surface water COCs. In addition, marine CAWQC were not uniformly available for all detected chemicals. In these instances, surrogate chronic benchmark values were derived following the same methods used to derive surrogate freshwater values.

In addition to comparisons to marine CAWQC, maximum and average contaminant concentrations in Thames River and Goss Cove surface water were compared to acute marine benchmarks when they exceeded CAWQC. CTDEP saltwater WQS were preferentially used. When CTDEP benchmarks were not available, acute saltwater AWQC were used.

Several of the inorganic chemicals detected in surface water samples collected from both the Thames River and Goss Cove were present in concentrations exceeding background concentrations (e.g., calcium, magnesium, potassium, sodium) are considered to be nontoxic and were eliminated from further consideration.

All chemicals present in excess of NSB-NLON background concentrations (inorganics only) and benchmark values (for both inorganics and organics) were considered Thames River surface water COCs.

Drinking Water

Wildlife receptors may be exposed to surface water COCs via ingestion. Inorganic COCs in surface water (for wildlife) were identified by comparing concentrations of inorganics to NSB-NLON background concentrations. The concentrations of all inorganics that exceeded background concentrations and all organic compounds detected were then used to conservatively calculate doses (see Section 3.4.4.2) that could potentially be received by various wildlife species inhabiting and/or utilizing specific areas on the NSB-NLON. These estimated doses were then compared to benchmark values protective of these receptors. Chemicals present in concentrations in excess of these benchmark values were regarded as surface water COCs with respect to terrestrial wildlife. The process used to develop benchmarks is described below.

Information on the toxicity of environmental chemicals to terrestrial wildlife is generally limited. Most information generated to date involves impacts of agricultural compounds on non-target wildlife species; little information exists on the impact of industrial chemicals on ecological receptors (Opresko et al., 1994). Furthermore, many of the data that are available reflect acute exposures (e.g., exposure to unrealistically high concentrations), and interpretation of the potential effects of long-term, chronic exposure on wildlife populations is difficult. Because of these and other data limitations, species-specific NOAELs (no-observed-

adverse-effects levels) for chronic exposures to a given chemical must be derived from the results of laboratory toxicity tests performed on different species of wildlife or, more frequently, on laboratory animals.

For this BERA, No-Observed-Adverse-Effects-Levels (NOAELs), and Lowest-Observed-Adverse-Effects-Levels (LOAELs) were obtained for both domestic and wild mammals and birds from the primary literature; USEPA review documents; and secondary sources such as the Registry of Toxic Effects of Chemical Substances, the Integrated Risk Information System (IRIS) and Opresko et al. (1994). NOAELs and LOAELs represent daily dose levels normalized to the body weight of the test animals. To reduce the need to extrapolate between data and to limit the uncertainty associated with deriving NOAEL values, emphasis was placed on those studies in which reproductive and developmental endpoints were considered (e.g., toxicity test endpoints indicative of potential population-level effects).

Although toxicity test data that reflected potential long-term (chronic) impacts to test organisms was preferentially sought, these types of data are not uniformly available. In order to derive reproductive RfD values for each of the representative ecological receptors considered in this BERA, a series of "Uncertainty Factors" (UFs) were applied to NOAEL data. UFs are designed to account for the uncertainty associated with extrapolating from toxicity data experimentally obtained from one organism in order to estimate the potential toxic impact on another receptor organism (CalEPA, 1996). UFs are multiplicative, such that an uncertainty factor of 25 is the product of two single UFs of 5. The magnitude and number of UFs applied to a given NOAEL is based on the number, quality, duration, and sensitivity of the studies used to assess the toxicity of a given chemical and the taxonomic relationship between the species actually tested and the representative receptor species being evaluated in the risk assessment (CalEPA, 1996).

UFs greater than 1 were used to compensate for the following (CalEPA, 1996):

- Study durations of less than one full life cycle when the most sensitive stages of the lifecycle were not tested (UF = 10)

The following UFs are applied when study results that reflect less sensitive toxicity endpoints (e.g., results based on endpoints other than reproduction, behavior, or pathology):

- To adjust from endpoints such as mortality to more sensitive endpoints (LD₅₀ to LOAEL Acute), UF = 5
- To adjust from less than chronic to chronic exposure (LOAEL Acute to LOAEL Chronic), UF = 5

- To adjust from observable effect to no observable effect (LOAEL Chronic to NOAEL Chronic),
UF = 5

The UFs listed below are used when interspecies extrapolations are necessary between taxonomically distant species (i.e., species belonging to different families or orders). Although a thorough review of available toxicity data was not performed in developing this set of UFs, it was felt that the UFs did represent a reasonable compromise between using no uncertainty factors and using an uncertainty factor of 10 for each level of extrapolation (CalEPA, 1996). As noted by CalEPA (1996), the following UFs are within the range of the geometric mean of four for interspecies chronic and subchronic NOAEL comparisons based on studies of uncertainty factors currently under review by the USEPA:

- Toxicity Extrapolations within the Class Mammalia:
 - Within the same taxonomic order: UF = 2
 - Between taxonomic orders: UF = 5
- Toxicity Extrapolations from Class Mammalia to Class Aves: UF = 10

Although no clear guidance has been developed to define what constitutes a subchronic exposure, both USEPA (1993a) and Opresko et al. (1994) consider exposure periods of less than 50% of a species' lifespan to represent a subchronic exposure period for mammalian species. This same definition of subchronic exposure was used in this BERA. As outlined in Opresko et al. (1994), information defining chronic/subchronic exposure periods for avian toxicity tests is even more limited and these tests are not well standardized. Therefore, an exposure period of 10 weeks or less will be defined as a subchronic exposure period for avian species (Opresko et al., 1994).

The derivation of reference doses (RfDs) for each chemical of concern and each receptor species considered in this BERA is summarized in Tables 3-19 through 3-25. The specific receptors considered by table are shown below:

- Herring Gull - Table 3-19
- Red-Tailed Hawk - Table 3-20
- Raccoon - Table 3-21
- Mallard - Table 3-22
- Barred Owl - Table 3-23
- Cormorant - Table 3-24
- Short-Tailed Shrew - Table 3-25

These representative species are discussed in Section 3.4.3.4.

These tables list the COCs test species used in each toxicity test, the endpoint used to quantify the toxic response of the test organisms, and the laboratory toxicity test result [expressed as a dose (mg/kg/day)]. The UF values applied to these test results are also listed. The following formula was used to calculate the final UF, which is defined as the product of the reciprocals of all applicable individual UFs:

$$Final\ UF = \frac{1}{(UF_a * UF_b * UF_c * ...UF_x)}$$

As noted above, receptor-specific RfD values were then derived by multiplying the laboratory test result by the chemical-specific final UF:

$$\text{Receptor-Specific RfD (mg/kg/day)} = \text{Final UF} * \text{Laboratory Test Result (mg/kg/day)}$$

Benchmark values used to identify COCs for terrestrial receptors are summarized in Table 3-17.

3.4.2.2 Sediment

Sediment COCs were identified by comparing conservative, representative concentrations of analytes present in sediment samples collected from onsite freshwater bodies (e.g., the Area A Wetland) and from the Thames River to NSB-NLON background concentrations (inorganics only) and to values protective of aquatic biota. The process used to derive benchmark values and to select sediment COCs is summarized below by freshwater systems, Thames River and Goss Cove, and terrestrial vertebrates. Benchmark values used to identify sediment COCs are summarized in Table 3-17.

Freshwater Systems

With the exception of lead, all inorganics detected in onsite sediment samples were compared to concentrations of inorganic constituents from their respective offsite reference locations. In reviewing the concentrations of inorganic constituents in the reference locations, it was apparent that one of the samples collected from Niantic Pond contained lead in concentrations significantly greater than concentrations measured in sediments collected from other reference locations. Following a series of discussions between BRE, the Navy, USEPA Region I, and CTDEP, it was determined that the concentration of lead detected in

samples collected from Pequot Woods would serve as the background concentration for lead for all onsite pond locations.

Those inorganic analytes present in concentrations greater than background concentrations and all organic compounds were compared to benchmark values protective of aquatic biota. The process used to identify benchmark values and to select final sediment COCs is described in the following paragraphs.

Unlike surface waters, national criteria have not been established for chemicals in sediments. The current lack of sediment criteria is largely a function of the difficulties associated with identifying biologically available concentrations. Adverse impacts associated with contaminated sediments are primarily related to the concentration of chemical present in interstitial (i.e., "pore") water. The adsorption/desorption of chemicals from sediment particles into interstitial water is governed by complex, interrelated chemical and physical processes. Models (e.g., equilibrium partitioning; EqP) have been developed to predict the concentration of non-polar organic compounds and some cationic metals that may be dissolved into interstitial water and biologically available. However, no equivalent, widely accepted models currently exist for predicting the partitioning of most metals or polar organics between water and sediment particles. As a result of these factors, separate approaches were used to identify sediment benchmarks for inorganic and organic compounds.

Inorganic Chemicals

Sediment guideline values developed by the Ontario Ministry of the Environment (OME 1992) served as benchmark values for sediment samples collected from freshwater systems. The values developed by OME are specifically developed to be protective of benthic aquatic organisms. Although several different approaches for developing sediment guidelines were evaluated, OME selected the "Screening Level Concentration Approach" or SLC to develop sediment guidelines. The SLC uses field generated data that documents the co-occurrence of benthic infaunal species and different concentrations of chemicals in sediment. The SLC is an estimate of the highest chemical of a contaminant that can be tolerated by a specific portion of benthic species. As defined by OME (1992), the SLC represents the concentration that 95% of the species can tolerate. The basic underlying assumption associated with this method of generating sediment quality guidelines is that the available data cover the entire range of tolerance for each benthic species considered. However, OME acknowledges that the full range of tolerance for most species is not known (OME, 1992).

In those instances where OME sediment guideline values did not exist for a particular inorganic, surrogate values developed by Washington State Department of Ecology (Washington State, 1994) were employed to identify sediment inorganic COCs for the Area A Downstream Watercourses and OBDA.

Also, when chronic sediment benchmarks were exceeded, maximum and average inorganic contaminant concentrations were compared to "acute" sediment benchmarks. Since sediment benchmarks are not generally derived to represent acute exposures, the Severe Effect Levels (SELs) from the OME data were used for freshwater systems investigated in the ERA. The SEL is defined as the concentration above which pronounced disturbance in the benthic community would occur. When SELs were not available, sediment benchmarks were obtained from other sources, including Long et al. (1995).

A number of inorganic chemicals detected in surface water samples collected from onsite waterbodies were present in concentrations exceeding background concentrations (e.g., calcium, magnesium, phosphorus, potassium, sodium). These chemicals are considered to be nontoxic and were eliminated from further consideration.

Organic Chemicals

As noted above, EqP models been developed to predict biologically available concentrations of non-polar organic compounds in sediment. The capacity of a sediment to adsorb organic chemicals is a function of the mass fraction of organic carbon in sediment, f_{oc} . A chemical's octanol/water partition coefficient (K_{ow}) provides an indication of the degree to which the chemical will be sorbed to sediment organic carbon and is therefore *not* biologically available. These relationships can be used to predict the amount of chemical that may be biologically available in a sediment containing a given amount of organic carbon. Based on these interrelationships, a site-specific organic carbon normalized benchmark criterion can be determined for a specific chemical having a specific organic carbon partition coefficient, independent of sediment properties (USEPA, 1993c).

Although K_{ow} values are routinely measured in the laboratory, K_{oc} values are seldom reported. However, K_{oc} can be predicted from K_{ow} . Using the K_{ow} values listed in Table 3-2, the following regression formula was used to predict K_{oc} (USEPA, 1993c):

$$\log_{10} K_{oc} = 0.00028 + 0.983 \log_{10} K_{ow}$$

The predicted K_{oc} value, in combination with chronic benchmark surface water values, was then used to predict site-specific chronic benchmark sediment values using the following formula (USEPA, 1993c):

$$\text{Site-specific sediment benchmark value} = \text{CAWQC} * f_{oc} * K_{oc}$$

Where: CAWQC = chronic ambient water quality criterion (mg/L)

f_{oc} = fraction of organic carbon (g/g)

K_{oc} = organic carbon partitioning coefficient

No widely recognized models have been developed to predict the concentration of polar organics present in interstitial water. Therefore, for the purposes of this BERA, it was assumed that these chemicals were completely dissolved in the interstitial water (i.e., mg/Kg = mg/L) and compared to chronic benchmark values.

Also, when chronic sediment benchmarks were exceeded, maximum and average organic contaminant concentrations were compared to "acute" sediment benchmarks. Since sediment benchmarks are not generally derived to represent acute exposures, the Severe Effect Level (SEL) from the OME data were used for freshwater systems investigated in the ERA. When SELs were not available, sediment benchmarks were obtained from other sources, including Long et al. (1995) although it is acknowledged that those values were derived primarily for marine systems. Due to the complexity of the Area A Downstream system and variability in organic carbon in that area, site-specific acute benchmarks were calculated using EqP for that site. Site-specific acute sediment benchmarks were not calculated for the other sites investigated in the ERA.

Thames River and Goss Cove

Inorganic Chemicals

Sediment samples were collected from the Thames River and Goss Cove in 1993 (Phase II RI) and 1995 (Phase II RI Supplemental Ecological Investigation). As discussed above, no true "upstream" reference station exists for the sampling stations on the Thames River. In order to distinguish concentrations of inorganics attributable to naturally occurring conditions (versus those that may be attributable with activities on the NSB-NLON), average concentrations of inorganic constituents reported in sediments collected from two locations in Long Island Sound (NOAA, 1994) were selected to represent background sediment conditions for the Thames River and Goss Cove (Table 3-26).

Because OME values were developed specifically for freshwater systems, values developed by Long and Morgan (1991) and updated in Long et. al (1995) were chosen to serve as benchmark values for inorganics in the Thames River and Goss Cove. Long and Morgan developed "apparent effects" data sets for various sediment toxicants by compiling biological effects data (e.g., reductions in marine benthic populations) for a specific toxicant, placing these data in ascending order (toxicant concentration producing no effect to toxicant concentration producing the greatest effect and then identifying the 10th and 50th percentile of these ordered data. Long and Morgan defined the 10th and 50th percentiles as the "Effects Range-Low" (ER-L) and the "Effects Range-Median" (ER-M), respectively, for each chemical considered. The more conservative ER-L values was used to identify sediment inorganic COCs for the Thames River and Goss Cove.

ER-L values have not been derived for several inorganics measured in Thames River sediment samples. For these analytes, surrogate values were selected from other sources, including sediment quality criteria established by various government agencies. In several instances, sediment-specific criteria could not be identified; these inorganics were therefore retained as COCs if present in concentrations in excess of background concentrations.

Also, when chronic sediment benchmarks were exceeded at Goss Cove or Thames River, maximum and average organic contaminant concentrations were compared to "acute" sediment benchmarks. Since sediment benchmarks are not generally derived to represent acute exposures, Effects Range-Median (ER-M) values from Long et al. (1995) were used for marine systems investigated in the ERA. When ER-Ms were not available, sediment benchmarks were obtained from other sources, such as OME (1992), although it is recognized that these values were derived primarily for freshwater systems. Due to the complexity of the Area A Downstream system and variability in organic carbon, site-specific acute benchmarks were calculated using EqP for that site. Site-specific acute sediment benchmarks were not calculated for the other sites investigated in the ERA, including Goss Cove and Thames River.

Several of the inorganics detected in sediment samples collected from both the Thames River and Goss Cove were present in concentrations exceeding background concentrations (e.g., calcium, magnesium, potassium, sodium) are considered to be nontoxic and were eliminated from further consideration.

In addition to ER-L values, the concentrations of five cationic metals present in sediments collected from the Thames River and Goss Cove in 1995 were also compared to site-specific metals criteria developed for each sample. Numerous studies have demonstrated that the concentration of acid volatile sulfide (AVS) present in sediments represents a major factor in influencing the pore water concentration and bioavailability

of metals in sediments. Sediments with concentrations of AVS in excess of the concentration of metals will have very low metal activity in the interstitial water (USEPA, 1994c); metals present in these sediments are unlikely to bioaccumulate or to be toxic. These relationships have been used to develop EqP methods for predicting the bioavailability of divalent metals in sediments (USEPA, 1994c) and for developing site-specific sediment benchmark values.

The EqP process can not be used to develop separate metal-specific (e.g., copper) sediment criteria. This is because cationic metals (e.g., copper, lead, cadmium, nickel, zinc) have differing affinities for AVS. The presence of two or more of these metals in sediments alters the amount of AVS available for binding the remaining cations (USEPA, 1994). The equilibrium models developed by USEPA (1994c) account for the fact that metals act in an additive fashion when binding to AVS. That is, "each of the five metals: Cu, Pb, Cd, Zn, and Ni will bind to the AVS and be converted to CuS, PbS, CdS, ZnS, and NiS in this sequence; i.e., in the order of increasing solubility" (USEPA, 1994c). Simultaneously extracted metals (SEM) are defined as the metals extracted in the cold acid used in the procedure to quantify AVS. SEM provides an indication of the biologically available concentrations of metals present in sediment pore water. The term $[SEM_i]$ represents the excess SEM for each of the i^{th} metals. The least soluble metal sulfide considered in USEPA (1994c) is copper sulfide. If the copper SEM is less than the AVS ($SEM < AVS$), then all of the copper SEM is present as copper sulfide and the $[copper\ SEM] = 0$. The remaining available AVS can be calculated as follows:

$$\text{Remaining [AVS]} = [\text{AVS}] - [\text{copper SEM}]$$

This computation is repeated for the next least soluble metal (Pb) and so on. In essence, AVS is "assigned" to the metals in the sequence of their solubility products from the lowest to the highest: $SEM_{copper} < SEM_{lead} < SEM_{cadmium} < SEM_{zinc} < SEM_{nickel}$. That is, AVS would be complexed first to copper, followed by lead, etc., until all AVS is exhausted. Once AVS is depleted, the remaining metals may exist as excess SEM and may be biologically available.

The USEPA has determined that site-specific sediment criteria can be developed based on the relationship between AVS and these cationic metals. A sediment will meet its site-specific sediment criterion if the sum of the molar concentrations of SEM_{copper} , $SEM_{cadmium}$, SEM_{nickel} , SEM_{lead} and SEM_{zinc} are less than the molar concentrations of AVS (USEPA 1994). However, even though a sediment meets its site-specific sediment quality criterion, the criterion is specific only for these five cationic metals and does not mean that a sediment is not toxic.

In addition to deriving site-specific metals criteria, USEPA's National Sediment Inventory program has developed the following preliminary classification scheme for the sum of the molar concentrations of SEM_{copper} , $SEM_{cadmium}$, SEM_{nickel} , SEM_{lead} , SEM_{zinc} and AVS;

- $SEM - AVS > 5$ indicates a high probability of adverse impacts to aquatic life
- $SEM - AVS = 0$ to 5 indicates a medium probability of adverse impacts and
- $SEM < 0$ indicates a low probability of adverse impacts

SEM concentrations of copper, cadmium, lead, nickel, and zinc were measured in sediment samples collected from the Thames River and Goss Cove in 1995. These concentrations, along with concentrations of AVS measured at these sample locations, were used to identify the bioavailability of these cationic metals (see Sections 13.0 and 17.0)

Organics

As was the case for freshwater systems (see Section 3.4.2.2.1), EqP was also used to derive sediment benchmarks that were then used to identify non-polar organic sediment COCs for the Thames River and Goss Cove. In this instance, marine CAWQC or appropriate surrogate values were used to derive these benchmark values. As previously noted, models to predict the concentration of polar organic contaminants present in interstitial water have yet to be developed. Therefore, it was again assumed that these Thames River and Goss Cove sediment constituents are completely dissolved in the interstitial water (i.e., mg/kg = mg/L); these hypothetical concentrations were then compared to chemical-specific surface water benchmark values to identify sediment polar organic COCs.

Terrestrial Vertebrates

Wildlife receptors may be exposed to sediment COCs through incidental ingestion while foraging. Wildlife receptor sediment inorganic COCs were identified by comparing concentrations of inorganics present in sediment samples to background concentrations. The concentration of all inorganic chemicals that exceeded background concentrations and all organic contaminants detected in sediment samples collected from a given location were then used to calculate conservative dose levels (see Section 3.4.4.2) that could potentially be received by various wildlife species inhabiting and/or utilizing contaminated areas on the NSB-NLON. These estimated doses were then compared to benchmark values protective of these receptors. Chemicals present in concentrations in excess of these benchmark values were regarded as final sediment

COCs with respect to terrestrial wildlife. The process used to develop benchmarks is described in Section 3.4.2.1 (Drinking water).

3.4.2.3 Soil

Soil COCs were identified by comparing conservative, representative concentrations of analytes present in soil samples collected from onsite locations (e.g., the CBU Drum Storage Area) to concentrations present in background locations (inorganics only). Information contained in Background Concentrations of Inorganics in Soil (Atlantic, 1995b) served as the source of background surface soil data for determining soil COCs. In defining soil COCs, potential impacts to terrestrial vegetation, soil invertebrates, and terrestrial vertebrates were considered. As a result, three different sets of benchmarks, selected to be protective of these three different groups of terrestrial receptors, were employed. The process used to derive these benchmark values and to select soil COCs is summarized below by terrestrial vegetation, invertebrates, and terrestrial vertebrates.

Terrestrial Vegetation

Surface soil inorganic COCs were identified by comparing inorganic contaminant concentrations to background soil concentrations. Inorganics that exceeded background concentrations were then compared to soil threshold values protective of terrestrial vegetation. Chemicals present in concentrations in excess of these benchmark values were regarded as final soil COCs with respect to terrestrial vegetation.

Benchmark phytotoxicity values developed by Will and Suter (1994) were used to identify soil COCs for terrestrial plants. As described in Will and Suter (1994), data used to derive these phytotoxic benchmark values were obtained from searches of bibliographic data bases, a numeric data base, review articles, and conventional literature. Plant growth and yield parameters were selected as endpoints for identifying potential adverse impacts; a 20% reduction in growth or yield was selected as the threshold for significant adverse effects (e.g., a 20% reduction in growth or yield represented the lowest observable effects concentration [LOEC]). The chemical benchmarks were derived by rank ordering of the LOEC values and identifying the tenth percentile from these ordered data. If there were 10 or fewer LOECs for a chemical, the lowest was used. This is the same methodology used by Long and Morgan (1991) and Long et al. (1995) to derive sediment benchmark values (Section 3.4.2.2). As acknowledged by Will and Suter (1994), these benchmark values are conservative and do not consider site-specific soil characteristics that can affect plant toxicity. Benchmark values used to identify soil COCs for terrestrial vegetation are summarized in Table 3-17.

Invertebrates

Surface soil inorganic COCs for soil invertebrates were identified by comparing inorganic concentrations to background concentrations. Inorganic chemicals that exceeded background concentrations were then compared to soil threshold values protective of soil invertebrates. Chemicals present in concentrations in excess of these benchmark values were regarded as final soil COCs with respect to these receptors.

Few benchmark values are available for soil invertebrates. Values obtained from the literature were used to identify inorganic COCs but endpoints to evaluate impacts of organic compounds in soil on these receptors had to be derived. In these instances, a computer program developed by USEPA (ECOSAR; USEPA, 1992c) was used to predict benchmark values for these contaminants. This program includes a series of models based on quantitative structure-activity relationships (QSAR) that permits the prediction of toxicity endpoints for a chemical based on the known toxicity of related chemicals to earthworms. Chemical-specific parameters used to make these predictions include $\log K_{ow}$, melting point, molecular weight, and the chemical's solubility in water (USEPA, 1992). Endpoints predicted by these models were 14-day LC_{50} (mg/L). These values were transformed by dividing by 100 (see Section 3.4.2.1) and were then compared to site-specific concentrations of organic chemicals predicted be present in soil moisture at a given location.

Using the fraction of organic carbon (foc) measured in surface soil samples, the following equation was used to determine site-specific concentrations of organic compounds present in the soil moisture:

$$\text{Soil Moisture Chemical Concentration (mg/L)} = \frac{\text{Soil Chemical Concentration (mg/kg)}}{K_{oc} \left(\frac{L}{Kg} \right) * foc}$$

Benchmark valves used to identify soil COCs for soil invertebrates are summarized in Table 3-17.

Terrestrial Vertebrates

As was the case for terrestrial vegetation and soil invertebrates, soil inorganic COCs for wildlife were identified by comparing concentrations of inorganics present in surface soil samples to background concentrations. The concentration of all inorganics that exceeded background concentrations and all organic compounds collected from a given location were then used to calculate conservative doses (see Section 3.4.4.2) that could potentially be received by various wildlife species through incidental ingestion of soil.

In addition to direct consumption of soil, potential risks to vertebrate receptors resulting from the consumption of prey were also evaluated. Chemical concentrations in soil were used to predict tissue concentrations of chemicals in earthworms. These predicted values were then used to predict tissue concentrations in small mammals (i.e., the short-tailed shrew) that preyed upon these types of organisms. Methods used to derive the exposure point concentrations in tissue are discussed in Section 3.4.4.1. These predicted tissue concentrations were used to calculate the potential dose received by vertebrate predators. These predicted doses were compared to benchmark values protective of these receptors in order to evaluate potential risks associated with this exposure pathway. Chemicals present in concentrations in excess of these benchmark values were regarded as final soil COCs with respect to terrestrial wildlife. The process used to develop benchmarks was described in Section 3.4.2.1. Benchmark values used to identify COCs for terrestrial invertebrates are summarized in Table 3-17.

3.4.3 Basewide Conceptual Model

This section discusses the CSM for chemicals associated with the NSB-NLON. A CSM facilitates consistent and comprehensive evaluation of the risks to ecological receptors by creating a framework for identifying the paths by which ecological receptors may be exposed to various NSB-NLON contaminants. The CSM outlines potential sources of contamination, release mechanisms, receiving media, fate and transport mechanisms, routes of exposure and ecological receptors. Ultimately, the CSM depicts the relationship between the elements necessary to construct a complete exposure pathway, by considering the following:

- Sources of contamination and receiving media
- Potential exposure pathways
- Complete exposure pathways
- Ecological endpoints

Several sources of contamination have been identified on NSB-NLON. The base was known to produce, handle, and dispose of wastes. Accidental spills from production and disposal practices included releases of chemicals into landfills, ponds, and storage tanks, have contributed to an increased presence of COCs in various media, potentially affecting the local environment. Many chemicals found in the soil or groundwater can be traced to specific processes, disposal areas, or storage facilities (tanks and basins) and may be the result of leaks, spills, seepage, or accidents such as fires or explosions. However, sites like the Area A Wetlands, which were artificially created with dredge spoil from the Thames River, may also contain chemicals from sources other than the NSB-NLON.

Contaminant sources include contaminated soil. Chemicals may be released from this source by mechanisms such as volatilization, wind or water erosion, or leaching to the subsurface. Once released from the source, chemicals are transported in media such as air, surface water, or groundwater. Receptors may be exposed either directly or indirectly to chemicals in these media via a variety of mechanisms or pathways such as ingestion of plants and animals growing on or in contact with contaminated soil, incidental ingestion of soil, etc.

3.4.3.1 Sources and Receiving Media

As described in Section 1.0, there are thirteen sites of concern at NSB-NLON. Each of these sites may release chemicals, resulting in contamination of media in the immediate vicinity of the site as well as possible contamination of distant areas (e.g., via surface water run-off).

Soil

Soil represents the primary source of chemicals at NSB-NLON. Chemicals may be released from this source by volatilization, wind erosion, and soil runoff.

Gases

NSB-NLON contaminants include both volatile and semivolatile organic chemicals. Because of their volatile nature, these chemicals may enter the atmosphere and be carried to other areas on the facility as well as offsite locations. Air can, therefore, serve as both a potential transport and an exposure medium.

Surface Water/Sediments

Chemicals released from soil may enter surface water via wind erosion and runoff. Soil particulates entrained in runoff could be removed from the site if the topography allows. Contaminants entrained in the suspended sediment or dissolved in the surface water represent potential risks to aquatic organisms coming in contact with material that may have been carried to water bodies associated with NSB-NLON (e.g., Thames River; Area A Downstream Watercourses/OBDA).

Leaching to Groundwater

Another potential migration pathway is the leaching of soluble constituents from the soil. Infiltrating precipitation may transport constituents found in the surface soil into the subsurface soil and the groundwater table. Ecological receptors could be exposed to chemicals present in the groundwater once it enters into surface water bodies.

3.4.3.2 Potential Exposure Pathways

An ecological receptor can come into contact with chemicals in a variety of ways, generally as a the result of the receptor's behavior and the presence of an exposure medium. Potential exposure pathways to site-related contaminants include: (1) inhalation of contaminated dust or air, (2) absorption or ingestion of contaminants from surface waters, (3) ingestion or absorption from suspended sediments, bedded sediments, and interstitial (pore) water, and (4) incidental ingestion of soil contaminants by terrestrial organisms and indirect uptake via the food chain, and exposure of transient species to contaminated soils. Exposure routes considered in this BERA are described below.

Air

This potential pathway is based on the presumption that a receptor is immersed in air containing suspended particulates and volatile organic vapors originating from various locations on the NSB-NLON; subsequent exposure of the receptor occurs upon inhalation of the ambient air. All air-breathing species could be exposed through airborne releases of vapors or dusts. Chronic exposure to low levels of volatile compounds is possible. Wind-blown deposition of particles from contaminated areas to vegetation, surface water or soils, is another potential exposure pathway. However, because most areas on the NSB-NLON are well vegetated or covered (i.e., parking lots), this exposure pathway is of limited importance to most ecological receptors and was not evaluated as part of this ecological risk assessment.

Surface Water

Exposure to contaminants through contact with surface water takes into consideration aquatic environments associated with open waters (e.g., streams in Area A Downstream Watercourses/OBDA) and associated Area A Wetlands. Surface waters in the developed sections of the site are all collected by an extensive storm sewer system and discharged to the Thames River. These sections of the site are mostly covered by

buildings and pavement runoff is not believed to come into contact with chemicals present in soils in these areas.

Potential exposure pathways for ecological receptors inhabiting or utilizing this medium include direct contact with and ingestion of surface water. Potential ecological receptors include aquatic emergent/submerged vegetation, benthic macroinvertebrates, amphibians, and residing or transient birds, and mammals.

Sediments

Contaminated sediments are associated with the Thames River, the wetlands and streams associated with Area A Wetland, the Weapons Center, and the waterbodies in the Area A Downstream Watercourses/OBDA. Potential receptors include benthic infaunal species, small mammals, and waterfowl. Potential routes of exposure of aquatic receptors to contaminants in this media include direct contact with and/or ingestion of sediments and/or prey.

Surface Soils

Terrestrial ecological receptors may be exposed to soils through direct contact, ingestion of soils and/or plants, and food chain uptake. Aquatic receptors may come into contact with soil as a result of surface water runoff carrying entrained particles to local water bodies. Aquatic receptors may be exposed to these chemicals via direct contact, incidental ingestion of sediments, or ingestion of prey.

3.4.3.3 Complete Exposure Pathways

An exposure pathway is considered to be complete if it is determined that there is 1) a release of chemicals from a source; 2) an exposure point where contact can occur; and 3) an exposure route by which ecological receptors may uptake contaminants. This section summarizes the complete exposure pathways evaluated in the BERA which are described below and summarized in Figures 3-6, 3-7, and 3-8. Risks to ecological receptors were calculated for each complete exposure pathway.

Exposure to Surface Water

This pathway was considered complete for aquatic biota (e.g., macroinvertebrates) inhabiting onsite water bodies, as well the Thames River and Goss Cove. Terrestrial receptors inhabiting the NSB-NLON may be

exposed to chemicals present in various onsite water bodies via ingestion of drinking water. This pathway is not applicable to the Thames River and Goss Cove; it is unlikely that terrestrial receptors would use the river in the vicinity of the NSB-NLON as a source of drinking water due to its brackish nature.

Direct Contact and/or Incidental Ingestion of Sediments

As previously discussed, it is possible that receptors such as benthic biota or waterfowl may come in contact with chemicals that may have washed into various onsite water bodies and the Thames River. These organisms may come in direct contact with chemicals present in these sediments or they be exposed indirectly (incidental ingestion of sediments or prey).

Incidental Ingestion of and Dermal Contact with Soil

Ecological receptors may be exposed via incidental ingestion of soil. Soil invertebrates may be exposed via dermal contact with soil. While terrestrial vertebrates may be exposed to contaminants via dermal contact, this exposure pathway is not believed to be significant for these receptors in that most are covered with fur or feathers, limiting the amount of soil that may come into direct contact with the skin. Instead, these receptors are much more likely to be exposed through incidental ingestion while grooming or foraging for food.

Ingestion of Contaminated Prey

Chemicals may also be present in prey consumed by the ecological receptors inhabiting the NSB-NLON and the Thames River. Chemicals present in soil may be subsequently transferred into prey tissue (e.g., soil invertebrates or small mammals). Predators feeding on these prey organisms are eventually exposed.

3.4.3.4 Ecological Endpoints

As discussed in the Ecological Risk Assessment Guide (USEPA, 1994d), one of the major tasks in the Problem Formulation step of an ecological risk assessment is to identify assessment and measurement endpoints. An assessment endpoint is defined as "an explicit expression of actual environmental values that are to be protected" (USEPA, 1994d). Measurement endpoints are "measurable responses to a stressor that are related to the valued characteristics chosen as the assessment endpoints" (Suter, 1990). The CSM described above provides an indication of how chemicals associated with activities at NSB-NLON might come in contact with ecological receptors. The model also provides an indication of the relationship

between assessment and measurement endpoints identified for NSB-NLON. For this assessment, ecological risk assessment endpoints include any likely ecological effects associated with complete exposure pathways.

The maintenance of receptor populations served as the assessment endpoint considered for this BERA. Therefore, one of the specific objectives of this assessment was to determine if chemical concentrations in soil, surface water, and sediments are likely to result in declines in receptor populations. Declines in populations could result in a shift in the demographic structure of the community, effectively resulting in a shift in community structure and possible elimination of resident populations.

Measurement endpoints selected to determine whether or not these populations may be adversely impacted included endpoints indicative of potential adverse reproductive impacts. As discussed in Section 3.4.3, contaminants have been identified in soil, sediment, groundwater, and surface water samples collected from various locations on NSB-NLON. For ecological receptors that may come in contact with these media, conservative benchmarks were utilized to evaluate potential impacts of associated chemicals. The benchmarks developed for this BERA were based on values that were indicative of impacts to the reproductive success of receptor organism populations (Section 3.4.2).

In addition to these benchmark values, results of macroinvertebrate community studies, sediment toxicity tests, earthworm toxicity tests, frog embryo-larval toxicity tests, and tissue analyses also served as measurement endpoints to assess potential impacts to populations of receptor organisms.

Receptor Organisms

Representative species should be selected from those ecological guilds that may potentially be maximally exposed to and/or impacted by chemicals associated with the NSB-NLON. Additional criteria for selection includes sensitivity of the representative species, availability of data for the representative species, the relationship of the representative species to the species or functional group being evaluated, consistency of exposure scenarios with the species or functional groups being evaluated, and the availability of suitable test protocols should testing be necessary as part of a validation study.

Representative receptors organisms were selected based on a review of the habitat and communities associated with the NSB-NLON and the complete exposure pathways between contaminants and potential receptor organisms. To assess potential risks, aquatic biota, terrestrial vegetation, and terrestrial soil invertebrates were selected as representative species to assess potential impacts to ecological receptors

associated with the NSB-NLON. In addition, the following vertebrate species were selected to serve as representative receptor species for the NSB-NLON:

Short-Tailed Shrew

The short-tailed shrew (*Sorex sp.*) is a representative small mammal found in this portion of Connecticut and its behavior, feeding patterns, etc. are similar to those of small mammals that may utilize this area. The short tailed shrew inhabits a wide variety habitats, but most are characterized by cool, moist areas with abundant vegetative cover (Miller and Getz, 1977; Randolph, 1973). The short-tailed shrew feeds primarily on insects, earthworms, slugs, and snails, although plants, fungi, millipedes, centipedes, arachnids, and small mammals are also consumed (Hamilton, 1941; Whitaker and Ferraro, 1963). Small mammals are only consumed when invertebrates are not available. Short-tailed shrews inhabit round, underground nests and runways which are primarily confined to the top 10 cm of soil, but can be as deep as 50 cm. The short-tailed shrew stores food, especially during fall and winter (Hamilton, 1930; Martin, 1984). Short-tailed shrews consume only 10% of their prey; up to 86% is cached (Robinson and Brodie, 1982). The food ingestion of the short-tailed shrew was measured to be 7.95 g/day, and food consumption is approximately 40% greater in the summer than in the winter. Inhalation ($0.026 \text{ m}^3/\text{day}$) and surface area (54 cm^2) were estimated using equations based on body weight that were developed by Stahl (1967) as reported in EPA (1993a) (Table 3-27).

Raccoon

The raccoon (*Carnivora procyonidae*) was selected as an ecological receptor for the NSB-NLON because it is common in the area and frequents aquatic habitats (e.g., Area A Downstream Watercourses/OBDA). Additionally, the raccoon's life history and ecology is similar to that of other opportunistic mammals.

Raccoons are omnivorous and opportunistic feeders that feed primarily on fruits, nuts and corn, but also eat insects, grains, frogs, crayfish, and virtually any animal or vegetable matter. Raccoons are common near aquatic habitats (for foraging and drinking), frequent dumps, and inhabit developed areas. The following information on the raccoon was obtained from USEPA (1993a) and is summarized in Table 3-27: a body weight of 3,690 grams (Johnson, 1970); food ingestion rate of 135.6 g/day (estimated using USEPA, 1993a); inhalation rate of $2.17 \text{ m}^3/\text{day}$ (USEPA, 1993 - estimate); skin surface, $3,414 \text{ cm}^2$ (USEPA, 1993a - estimate).

Red-Tailed Hawk

The red-tailed hawk (*Buteo jamaicensis*) is a representative avian predator for the terrestrial habitats (wetland, old field, and woodland) found at the NSB-NLON and its behavior, feeding patterns, etc. are similar to other predaceous birds that may utilize this area. This large raptor feeds primarily on small mammals (mice, squirrels, and rabbits) and is expected to nest in the NSB-NLON area. The hawk is commonly observed soaring over open farmland, fields, and desert but does most of its actual hunting from perches such as telephone poles, fence posts, trees, and rock outcrops (MacMahon, 1987). The following information on the red-tailed hawk was obtained from USEPA (1993a) and is summarized in Table 3-27: a body weight of 1,028 grams (Craighead and Craighead, 1956); food ingestion rate of 102.8 grams/day (Craighead and Craighead, 1956); inhalation rate of 0.42 m³/day (estimated from Lasiewski and Calder, 1971); skin surface, 1021 cm² (estimated from Waldsberg and King, 1978).

Herring Gulls

The herring gull (*Larus argentatus*) was selected as an ecological receptor for the riverine area because it is representative of opportunistic carnivorous birds and is known to inhabit the Thames River in the vicinity of the NSB-NLON.

Nesting colonies of herring gulls in the northeastern United States are found primarily on sandy or rocky offshore or barrier beach islands (Kadec and Drury, 1968). Also, herring gulls in the northeast U.S. are generally migratory (Burger, 1982; Pierotti, 1988). Herring gulls feeding habits are defined primarily by availability, but generally consist of fish, squid, crustacea, molluscs, worms, insects, small mammals, and birds, duck and gull eggs, chicks, and garbage (Bourget, 1973; Burger, 1979; Fox et al., 1990; Pierotti and Annett, 1987). However, individual pairs of herring gulls have been reported to specialize on foraging for one type of food (Pierotti and Annett, 1987; 1991). Herring gulls feed at sea by aerial dipping and shallow diving around prey concentrations (McCleery and Sibly, 1986; Pierotti, 1988). Herring gulls that feed at sea often may range tens of kilometers from their nest to forage, while those feeding in the intertidal zone may travel less than one kilometer (Pierotti and Annett, 1987; 1991). The following information on the herring gull was obtained from USEPA (1993a) and is summarized in Table 3-27: a body weight of 951 grams (Norstrom et al., 1986); food ingestion rate of 200 grams/day (estimated from Pierotti and Annett, 1991); inhalation rate of 0.41 m³/day (estimated from Lasiewski and Calder, 1971); skin surface, 1001 cm² (estimated from Waldsberg and King, 1978).

Mallard Duck

The mallard duck (*Anas platyrhynchos*) was chosen as an ecological receptor for the freshwater ponds and wetlands. Its ecology makes it representative of other ducks and waterfowl that may use the NSB-NLON area.

Mallards preferentially feed in natural bottomland wetlands and rivers and water depths of 20 to 40 cm of the water depths are optimal for feeding. This species feeds off the bottom of wetland and riverine areas by submerging its bill to pick seeds of plants from the sediments, making it susceptible to incidental ingestion of contaminants in sediments. In addition to seeds, mallards also feed on aquatic invertebrates and insects, and other plant matter. The composition of the mallard's diet varies cyclically with the seasons. The following information on the mallard was obtained from USEPA (1993a) and is summarized in Table 3-27: a body weight of 1,043 grams (Nelson and Martin, 1953); food ingestion rate of 59.8 g/day (estimated using USEPA, 1993); inhalation rate of $0.42 \text{ m}^3/\text{day}$ (estimated from USEPA, 1993a); skin surface, $1,030 \text{ cm}^2$ (estimated from USEPA, 1993a).

Double-Crested Cormorant

The double-crested cormorant (*Phalacrocorax auritus*) is a representative piscivorous avian predator found on the Thames River near the NSB-NLON. Its behavior, feeding patterns, etc. are similar to diving birds that may utilize this area. The double-crested cormorant nests in rocky areas and stands of trees near water (both salt or freshwater systems). The double-crested cormorant remains near the coast and feeds in shallow water (<5-8m), eating a variety of fish taken from fresh and saltwater bodies (Croxall, 1987). The ecology of the double-crested cormorant is similar to that of other piscivorous birds living near NSB-NLON. In extreme northern areas, the double-crested cormorant winters in southern areas of its home range (Terres, 1991). The food ingestion of the double crested cormorant was estimated to be 94 g/day using an allometric equation based on body weight. Similarly, inhalation ($0.72 \text{ m}^3/\text{day}$) and surface area ($1,600 \text{ cm}^2$) were estimated using equations developed by Stahl (1967) as reported in USEPA (1993a) (Table 3-27).

Barred Owl

The barred owl (*Strix varia*) is a representative nocturnal avian predator for the wooded terrestrial habitats found at the NSB-NLON and its behavior, feeding patterns, etc. are similar to other predaceous birds that may utilize this area. The barred owl is commonly found in deep, deciduous, swampy woods such as those

associated with the Area A Downstream Watercourses/OBDA and was selected as an ecological receptor for these habitats. The barred owl feeds primarily on mice, but also feeds on many other small mammals and birds. The barred owl typically nests in tree cavities and abandoned nests (Terres, 1991) and is expected to nest in the NSB-NLON area. The barred owl does not migrate and is active resident year round. Food ingestion was estimated to be 43 g/day using an allometric equation based on body weight (Nagy, 1987). Similarly, inhalation was estimated to be 0.38 m³/day (Lasiewski and Calder, 1971) and surface area was estimated to be 40 cm² (Waldsberg and King, 1978; Table 3-27).

Macroinvertebrate Community Analyses

The macroinvertebrate community in the Thames River and in the waterbodies in the Area A Downstream Watercourses/OBDA were sampled as part of the Phase II RI and the Phase II RI Supplemental Ecological Investigation. The methods described below were used to evaluate these communities.

Shannon-Weaver Diversity Index

The Shannon-Weaver diversity index was used to characterize species diversity which is a function of the number of species per sample and the evenness with which individuals are distributed among the species. It is calculated as:

$$H = - \sum_{j=1}^{j=t} (p_j)(\ln p_j)$$

where: H = Shannon-Weaver diversity index
t = total number of taxa
p = proportion of individuals belonging to the ith taxa
i = individual taxon

The higher the value of the Shannon-Weaver index, the more diverse the community. Boesch (1972) and Swartz (1972) have shown that diversity generally decreases with decreasing water quality but low diversity may be caused by factors other than water quality such as extremes in weather conditions, poor habitat, or seasonal fluctuations (USEPA, 1992c).

Community Biotic Index Rating

The community biotic indices use pollution tolerance scores for a given taxon that are then weighted by the number of individuals assigned to each tolerance value. Although the use of community indices is generally limited to lotic systems (i.e., streams and rivers) impacted by organic (e.g., nutrient enrichment) pollution (USEPA, 1992c), community indices were calculated for all locations sampled as part of this program. The community biotic index ratings were calculated using the Hilsenhoff Biotic Index. Values range between 0 and 11, with lower values being indicative of less impacted systems (Hilsenhoff, 1987).

EPT Index

The EPT Index is the total number of distinct taxa within the orders Ephemeroptera, Plecoptera, and Trichoptera. This index generally increases with improving water quality. This index summarizes taxa richness within the insect orders that are generally considered to be indicative of good water quality (i.e., that are pollution sensitive). Headwater streams that are naturally unproductive may experience an increase in taxa (including EPT taxa) in response to organic enrichment (USEPA, 1990). The EPT index is generally more suitable for evaluating lotic (stream) rather than lentic (pond) habitats.

Ratio of EPT to Chironomidae

The ratio of EPT to Chironomidae uses the relative abundance of these indicator organisms as a measure of community balance. Good biotic conditions are reflected in communities that have a fairly even distribution among all 4 of these major groups, with "substantial" representation among the Ephemeroptera, Plecoptera, and Trichoptera (USEPA, 1990). Systems with skewed populations will have a disproportionate number of the generally tolerant Chironomidae relative to the more sensitive insect groups (i.e., a low ratio), suggesting that these systems are environmentally stressed. As was the case with the EPT index, the ratio of EPT to Chironomidae is more appropriately applied to streams and rivers, rather than to ponds.

Ratio of Shredders to Total Numbers of Individuals

A comparison of the relative abundance of shredders to the total number of individuals provides an indication of potential impairment of a system. Shredders are generally regarded as being sensitive to riparian zone impacts and are particularly good indicators of toxic effects when toxicants can be readily absorbed to detritus and other organic material, which serves as the food source for these organisms (USEPA, 1990). A low ratio of shredders is indicative of stress.

Ratio of Scrapers to Filtering Collectors

The relative abundance of scrapers and filtering collectors in riffle/run habitat provides an indication of periphyton production and the availability of fine, suspended organic matter often associated with organic enrichment (USEPA, 1990). Scrapers typically increase in abundance with increases in diatom production and decrease in the presence of filamentous algae; which are associated with organic enrichment. Filamentous algae also provide good attachment sites for filtering collectors and are associated with conditions that promote an increase in the concentrations of fine particulate matter (i.e., organic enrichment) which serves as a food source for this group of macroinvertebrates (USEPA, 1990). Therefore, a high ratio is indicative of an unstressed system.

Index of Similarity to Reference Locations

The Index of Similarity was used to compare the similarity between the benthic communities at a reference and a study site, with high similarity indicating little change, or impact, between two sites. This type of index is commonly applied in situations when it is desirable to determine if community assemblages have shifted along a stream gradient or above and below a source of contamination (USEPA, 1990). The Index of Similarity (SI) was calculated as follows:

$$SI = \frac{2C}{A+B}$$

where: A equals the number of species at Site 1,
B equals the number of species found at Site 2, and
C equals the number of species common to both sites.

An SI of 6.5 to 7.0 indicates good similarity.

Indicator Species

One of the earliest approaches to assessing pollution impacts to benthos was to evaluate for the presence of hardy and opportunistic species which tolerate stress better than other species. This approach has only limited usefulness, however, since many of these opportunistic species may also be present in unstressed assemblages. This information was employed in a qualitative manner, when information for a particular species could be identified.

Although a systematic classification of opportunistic species does not exist, several investigators have classified benthic species as opportunistic for different environmental settings and conditions (Dauer, 1993; Boesch, 1977b; Pearson and Rosenberg, 1978). These species include relatively short-lived species that are tolerant of a wide variety of conditions and dominate disturbed or distressed habitats.

Bray-Curtis Measure of Similarity

The Bray-Curtis values (B) are calculated as:

$$B = 1 - \frac{\sum_{j=1}^{j=n} |x_{1j} - x_{2j}|}{\sum_{j=1}^{j=n} (x_{1j} + x_{2j})}$$

where: x_1 and x_2 are the number of individuals of the jth of n species for any two stations, respectively. In addition, because this measure is sensitive to occasional outstanding values, a square root transformation was first performed on the benthic data (Clifford and Stephenson, 1975; Pearson and Rosenberg, 1978). The Bray-Curtis index can range between 0.0 and 1.0, where values approaching 0.0 are dissimilar, and values approaching 1.0 are similar.

Expected Number of Taxa

A benthic invertebrate regression model developed as part of the USEPA's Environmental Monitoring and Assessment Program (EMAP) was used to evaluate whether the number of observed taxa at Thames River stations sampled during the Phase II RI reflect stress-free conditions (USEPA, 1994c). The model assumes that in the absence of chemical contaminants or low dissolved oxygen, the "expected" number of species will represent the response of the benthos to estuarine gradients in salinity and total organic carbon. The model calculates the expected number of species (E) as:

$$E = 8.25 + (3.87E-4 * TOC) - (1.9E-08 * TOC^2) + (0.784 * salinity) - (1.25E-3 * salinity^2) - (2.031E-5 * TOC * salinity)$$

where: TOC = total organic carbon in sediment, percent
salinity = salinity of water column near bottom, ppt

Statistical Analyses

The analysis also accounted for effects related to physical properties of the sediment. This assessment examined the statistical relationships among chemical concentrations in sediments, sediment characteristics such as TOC and grain size, and benthic community parameters such as total number of taxa per station, mean number of individuals per sample, and Shannon-Weaver diversity index. It did not account for geographical relationships among stations (i.e., upstream, downstream) or proximity to the NSB-NLON. While these statistical analyses cannot provide direct evidence of ecological impact (e.g., a cause and effect relationship), they help to identify associations between chemicals, benthic organisms, and sediment physical properties. The results of these analyses are summarized in Appendix G.3.

A zero order correlation matrix was used to evaluate potential linear relationships between the benthic community parameters, sediment chemistry, and sediment characteristics. A "zero-order" analysis does not account for sample covariance (e.g., when sediment chemistry and community parameters are correlated to each other and to sediment characteristics such as grain size). In addition, partial correlations were calculated to evaluate the linear association between community parameters and sediment chemistry, while adjusting for the linear affects of sediment characteristics, such as grain size (% silt/clay) and total organic carbon.

Sediment Triad

As discussed in Section 2.7, sediment samples were collected and analyzed in April 1995 (Phase II RI Supplemental Ecological Investigation) from the Area A Downstream Watercourses and OBDA. In addition to chemical analyses, the toxicity of each sediment sample to two freshwater macroinvertebrate species and frog embryos was determined. The macroinvertebrate community present at each of these locations was also characterized during this sampling period. These three types of data (chemical concentrations, toxicity, and macroinvertebrate community characteristics) were used to qualitatively describe the sediment quality associated with each of the waterbodies sampled. The method used to incorporate these data is referred to as the "Sediment Triad Approach" (Triad) and is commonly applied to identify areas where pollution-induced degradation is occurring within a system and to rank areas for possible remediation.

The three components of the Triad provide complimentary data; no single component can be use to predict the measures of the others. For instance, chemical data provide an indication of the degree and extent of contamination but can not accurately predict biological effects (USEPA,1992c). Differences in

macroinvertebrate community structure may be due to chemical contamination or may simply reflect physical differences (e.g., light or thermal regime, sediment type, etc.) between two locations.

The three components of the Triad integrate biological and chemical data. In doing so, the Triad provides the strongest evidence for identifying pollution-induced degradation to a system. If chemical concentrations and mortality are high and macroinvertebrate populations low for a given location, then the burden of evidence indicates degradation (USEPA, 1992c).

The following assumptions are generally made when applying the Triad approach (USEPA, 1992c):

- the approach allows for (1) interactions between contaminants with in sediments (e.g., additivity, synergism, etc.); (2) actions of unidentified contaminants; and (3) the effects of environmental factors on biological responses (e.g., current velocity, etc.)
- chemical concentrations are appropriate indicators of overall chemical contamination
- toxicity tests and macroinvertebrate community parameters are appropriate indicators of biological effects.

Several procedures exist for evaluating Triad data including ranking, multiple regression, and principle component analysis (Canfield, et al., 1994). Ranking methods developed by Kreis (1988) were used to rank the sediment chemistry, toxicity, and macroinvertebrate data collected from the Area A Downstream Watercourses/OBDA in April 1995. In applying this method, values for each individual variable considered in developing the Triad were scaled proportionally between 1 and 100; a value of 1 was assigned to the lowest and 100 assigned to the highest effect or chemical parameter recorded at a given station. This scaling method retains the relative magnitude of difference between measurements and results, permits a consistent scaling between different types of variables, and allows all data collected from a station to be integrated, so that a final rank can be assigned to each station (Canfield, et al., 1994, Kreis, 1988).

As recommended by Kreis (1988), ranks were assigned to the various Triad components as follows:

- each individual component measured at all stations (e.g., concentrations of copper) was listed in a column and scaled from high to low

- all scaled values for each station (i.e., each row) were summed for each generic parameter (e.g., chemical concentrations)
- the resulting sum for each station (row) was then scaled for that generic parameter.

This approach results in a scaled value for each generic variable (toxicity, chemistry, and macroinvertebrate community structure) considered in the Triad. The scaled values range between 1 and 100. These values were added to produce a final total rank for each station. The final ranks assigned to each station provides an indication of the sediment quality associated with each location investigated. The procedures used to assigned scaled ranks to each parameter are described in greater detailed below.

Chemical Ranks

Only the 7 onsite water bodies and 4 reference water bodies sampled as part of the Phase II RI Supplemental Ecological Investigation (April 1995) were used to determine chemical ranks. These water bodies are referred to as stations in the remainder of this section. These stations were separated into two groups (ponds and streams), and were ranked within their group. The maximum chemical concentrations reported for Niantic Pond and Stream 2 were used to assign ranks to these two locations.

Eighteen inorganic contaminants detected in these samples were individually scaled as described above. Several chemicals (e.g., calcium, magnesium, potassium, and sodium) were considered nutrients and eliminated from the ranking process. The following equation was used to scale these data (Kreis, pers. comm.):

$$Rank = 1 + \left[\frac{99 * (value\ to\ be\ ranked - lowest\ value\ of\ group)}{(highest\ value\ of\ group - lowest\ value\ of\ group)} \right]$$

If a chemical was not detected at a station, then the station was excluded from the scaling process for this chemical. When a chemical was detected at only one station, that station was assigned a rank of 100. As described above, ranks assigned to the individual inorganic chemicals were summed by station to create a total inorganic chemical rank each station by group (pond and streams).

Ranking the stations for organic chemicals detected in these samples was carried out in an identical fashion. A total of 36 individual organic chemicals was considered. The organic chemical ranks were based on bulk

sediment chemistry; total organic carbon was not used to determine site-specific concentrations of biologically available organic contaminants.

A total chemical sum was calculated by summing the organic chemical and inorganic chemical ranks for each station.

Toxicity Ranks

Three different toxicity tests were performed on sediment samples collected in April 1995 (Section 2.7). These tests included 10-day sediment toxicity tests for *Hyalella azteca* and *Chironomus tentans* and a FETAX (Frog Embryo Teratogenesis Assay *Xenopus*) study. Percent mortality in the *Hyalella azteca* and *Chironomus tentans* was the only endpoint that was ranked for the 10-day toxicity tests. Three endpoints (% mortality, % malformations, and mean growth) were ranked for the FETAX study. These toxicity test results were separated into two groups, ponds and streams, and were ranked within their group.

The ranking of percent mortality (all tests) and percent malformations were performed in an identical fashion to that described to scale the chemical data. The mean growth endpoint of the FETAX study was transformed before ranking. This was done to make the ranking system consistent across the three components of the Triad approach (chemical analysis, toxicity testing and macroinvertebrate community structure). This transformation was accomplished by inverting the mean growth value (i.e., $1/\text{mean growth}$). Inverting mean growth resulted in those stations exhibiting the least growth receiving the highest rank and stations with more growth were assigned lower ranks. This approach resulted in stations that were exhibiting adverse impacts (elevated chemical concentrations, high % mortality, low mean growth, low taxa number, etc.) to always be ranked high (towards 100). After transformation, the mean growth FETAX data were sorted and ranked using the equation given above in the same manner as the inorganic chemical data. The ranks of the 5 toxicity test end-points were summed to create a toxicity test rank for each station.

Macroinvertebrate Community Structure Ranking

The same 11 stations were also assigned ranks based on macroinvertebrate community structure. These stations were ranked for taxa richness, density and the Shannon-Weaver Diversity Index.

As described above, all three of these parameters were transformed by $(1/X)$ before ranking. Inverting these macroinvertebrate community parameters results in stations with the least taxa, diversity or density of organisms being assigned the highest rank; stations with greater numbers of taxa, and higher diversity or

density of organisms were assigned lower ranks. For the Shannon-Weaver diversity index (H'), a default value of 0.001 was used when $H' = 0$ in order to make the transformation and subsequent ranking possible.

After the community structure data was transformed, it was sorted high to low values and ranked as described above. The ranks of the 3 community structure parameters were summed to create a community structure sum for each station.

Overall Ranking

The total chemical rank, toxicity test rank, and community structure rank for each station was then ranked. Ranking was performed with the two groups (ponds and streams). This resulted in a total chemical scaled rank, toxicity test scaled rank and community structure scaled rank for each of the 11 stations. An overall ranking, which encompassed all three components of the sediment Triad, was calculated for each sampling station by its summing the total chemical, toxicity test, and community structure scaled ranks for each station and ranking the final values.

3.4.4 Exposure Assessment

The exposure assessment defines and evaluates exposure of receptor organisms to contaminants. In order for a receptor to be exposed to a contaminant, several factors must be present; first, there must be a source and release of contamination; second, there must be an exposure point by which a receptor can come into contact with the contaminants; and third, there must be route of exposure by which ecological receptors come in contact with the contaminated medium.

This section of the BERA defines the contaminant concentrations at the point of exposure and presents the equations used to quantify exposure in terms of contaminant intake (dose).

3.4.4.1 Exposure Point Concentrations

With the exception of contaminants present in soil invertebrates (earthworms) and small mammals (shrews), all contaminant concentrations used in the exposure assessment were based on measured (maximum or UCL, and average) concentrations. Methodologies used to predict contaminant concentrations in soil invertebrates and small mammals are discussed in detail below.

Quantifying Chemical Concentrations Present in Surface Water

All available qualified data collected from onsite waterbodies, the Thames River, and Goss Cove were used to determine exposure point concentrations. Surface water exposure point concentrations were determined by identifying the maximum concentration of contaminant present at a given location. When sufficient data were available, (e.g., $n > 10$), UCL values were calculated and used instead of the maximum concentration. When duplicate samples were collected at a sampling location, the average concentration of the two values (or 1/2 the detection limit if one of the two samples was reported as "not detected") was used to calculate the chemical concentration for this particular sampling event. In addition to evaluating risks due to exposure to the maximum concentration of a chemical, risks associated with exposure to the average chemical concentration were also assessed. Average exposure point concentrations were calculated using all positively detected, qualified data (or 1/2 the detection limit when both detected and undetected concentrations were reported for a given analyte) collected from a site.

The surface water exposure point concentrations for onsite locations and Goss Cove were based on waterbody. For instance, all data collected from Stream 1 were used to determine the maximum (or UCL) and average exposure point concentrations for this stream. However, because of the distance between sampling locations, surface water exposure point concentrations for the Thames River were based on measurements recorded at each station, rather than combining all data recorded from the river.

Quantifying Chemical Concentrations Present in Sediments

All available, qualified, chemical data collected from onsite waterbodies, the Thames River, and Goss Cove were used to determine sediment exposure point concentrations. Sediment exposure point concentrations were determined by identifying the maximum concentration of chemicals present at a given location. When sufficient data were available, (e.g., $n > 10$), UCL values were calculated and used instead of the maximum concentration. Per discussions with USEPA Region 1 and CTDEP, when duplicate samples were collected at a sampling location, the maximum concentration of the two values was used to represent the concentration for this particular sampling event. In addition to evaluating risks due to exposure to the maximum value of contaminant, risks associated with exposure to the average concentration of a contaminant present at a given location were assessed. Average exposure point concentrations were calculated using all positively detected, qualified data (or 1/2 the detection limit when both detected and undetected concentrations were reported for a given chemical) collected from a site.

The sediment exposure point concentrations for onsite locations and Goss Cove were based on waterbody. For instance, all data collected from Stream 1 were used to determine the exposure point concentrations for this stream. However, because of the distance between sampling locations, sediment exposure point concentrations for the Thames River were based on measurements recorded at each station, rather than combining all data recorded from the river.

Quantifying Chemical Concentrations in Surface Soil

All available qualified chemicals data collected from onsite locations were used to determine surface soil exposure point concentrations. Soil exposure point concentrations were determined by identifying the maximum concentration of contaminant present at a given location. When sufficient data were available, (e.g., $n > 10$), UCL values were calculated and used instead of the maximum concentration. Per discussions with USEPA Region 1 and CTDEP, when duplicate samples were collected at a sampling location, the maximum concentration of the two values was used to represent the concentration for this particular sampling event. In addition to evaluating risks due to exposure to the maximum value of an analyte, risks associated with exposure to the average concentration of a contaminant present at a given location were assessed. Average exposure point concentrations were calculated using all positively detected, qualified data (or 1/2 the detection limit when both detected and undetected concentrations were reported for a given chemical) were collected from a site.

Estimating Chemical Concentrations in Prey

Bioaccumulation factors (BAFs) were used to determine chemical concentrations in earthworm tissues. Values obtained from the literature were used to predict uptake of most inorganics. When literature values could not be identified, a conservative value of 1.0 was assumed. For organic compounds, the following equation (Markwell et al., 1989) was used to derived site-specific BAFs:

$$\text{Earthworm BAF} = Y_L(f_{oc})(0.66)$$

where: Y_L = earthworm % lipid content
 f_{oc} = fraction of organic carbon in soil
 K_{oc} = carbon partitioning coefficient

A lipid content of 8% was assumed for soil invertebrates based on the work of Stafford et al. (1988) on the earthworm *Lumbricus terrestris*. Table 3-28 summarizes BAF values and their sources.

The contaminant body burden for small mammals, as represented by the short-tailed shrew was determined as follows:

Small mammal body burden = contaminant dosage (mg/kg/d)*contaminant transfer

With the exception of DDT, DDE, and DDD, methods developed by Travis and Arms (1989) to predict the bioaccumulation of organic contaminants by cattle were used to predict the transfer factor for these contaminants by short-tailed shrews. DDT, DDD, and DDE transfer factors reported by Forsthe and Peterle (1984; 0.2) for shrews were used to predict body burden of these contaminants in this receptor.

Values contained in Baes et al. (1984) to predict the uptake of inorganics by live stock also served as transfer factors for the short-tailed shrew. Applying the methods developed by Travis and Arms (1989) and Baes et al. (1984) required the assumption that no differences exist between the affinity of cattle and shrews for these types of chemicals. It is also assumed that the short-tailed shrews fed exclusively in contaminated areas. Predicted shrew body burdens were used to predict the potential contaminant dose received by predators (red-tailed hawks and barred owls) from food.

3.4.4.2 Determining Doses

Conservative assumptions were used to provide an estimate of total doses received by terrestrial vertebrates. For instance, it was conservatively assumed that the area of use for potential terrestrial vertebrate receptors overlapped 100% with the site in question and that the chemicals were completely bioavailable. In addition, minimal body weights and maximum ingestion rates were used in formulas to calculate potential dose.

As discussed in Section 3.4.4.1, exposures were based on the maximum (or UCL) and average concentrations (either measured or predicted) of chemicals in various environmental media. Exposure model parameters are presented in Table 3-27 for the terrestrial vertebrate receptors considered in this BERA. These parameters were used in the equations presented in this section, along with the exposure point concentrations to calculate potential chemical intake (dose) by each receptor. These calculated intake concentrations were used to characterize potential risks. Individual chemical intakes for each receptor/exposure route combination are presented in Appendix I.

Based on the conceptual model summarized in Section 3.4.3 and the complete exposure pathways identified in Section 3.4.3.3, the following exposure pathways were considered for terrestrial vertebrate receptors:

- ingestion of surface water
- ingestion of contaminated prey items
- incidental ingestion of soil

Ingestion of Water

Ingestion of contaminated surface water is only applicable to terrestrial vertebrate receptors inhabiting the NSB-NLON; it was assumed that the Thames River and Goss Cove is too brackish to represent a viable source of drinking water. Absorption of chemicals present in water is also assumed to equal 1.0 (e.g., 100% of contaminant present in water was absorbed). The equation for water ingestion is as follows:

$$\text{PD water ingestion} = (C_{\text{water}} * \text{FI} * \text{AF} * \text{WI}) / (\text{WR} * \text{CF})$$

where: PD = predicted dose from drinking water ingestion (mg/kg/day)
C = concentration of a contaminant in water (mg/L = mg/kg)
FI = fractional intake (% of home range that overlaps impacted area; assumed to equal 100%)
WI = water intake (L/day = mg/day)
AF = absorption fraction (unitless; assumed to be 100%)
WR = weight of receptor (kg)
CF = conversion factor (kg to mg)

Incidental Ingestion of Soil

Incidental ingestion of soil (both intentional and incidental) was determined using the exposure point surface soil concentration (both maximum and average) of a given chemical. Intestinal absorption (AF) was conservatively assumed to equal 100%. Daily intake of chemical as a result of ingestion of soil was determined using the following equation:

$$\text{PD ingestion of soil} = (C_{\text{soil}} * \text{FI} * \text{SA} * \text{AF} * F) / (\text{WR} * \text{CF})$$

where: PD = predicted dose from ingestion of soil (mg/kg/day)
C = contaminant concentration in soil (mg/kg)
FI = fractional intake (% of home range that overlaps impacted area; assumed to be 100%)

SA	=	percent of diet that equals soil
AF	=	absorption fraction (unitless; assumed to = 100%)
F	=	food consumed (mg/d)
WR	=	body weight (kg)
CF	=	conversion factor (kg to mg)

Ingestion of Prey

The ingestion of prey was determined using exposure point concentration of a given chemical predicted to be present in soil invertebrates and short-tailed shrews (both maximum and average). Intestinal absorption (AF) was conservatively assumed to equal 100%. The following equation was used to estimate chemical intake from ingestion of contaminated food items:

$$\text{PD ingestion of prey} = (C_{\text{prey}} * F * FA * FI * AF) / (WR * CF)$$

where:	PD	=	predicted dose from ingestion of food items (prey; mg/kg/day)
	C	=	contaminant concentration (vegetation or prey; mg/kg)
	F	=	food consumed (mg/day)
	FA	=	animals as a percentage of diet
	FI	=	fractional intake (% of home range that overlaps impacted area; assumed to be 100%)
	AF	=	absorption fraction (unitless; assumed to = 100%)
	WR	=	weight of receptor (kg)
	CF	=	conversion factor (kg to mg)

3.4.5 Risk Characterization Methodology

Receptor-specific exposure concentrations (Section 3.4.4) were compared to Reference Doses (RfDs) or to media-specific (e.g., soil, sediment, and surface water) benchmark values (Section 3.4.2) to characterize potential risks. This approach is conservative and is likely to overestimate, rather than underestimate risk. The resulting risk values calculated in this manner integrate the predicted chemical concentration, receptor-specific exposure parameters, and chemical-specific toxicity.

The ratio of the exposure level or intake concentration to the RfD or benchmark value is called the Hazard Quotient (HQ) and is defined as follows:

$$HQ_i = \text{Intake}_i (\text{exposure concentration}_i) / \text{RfD}_i (\text{benchmark value}_i)$$

where: HQ_i = hazard quotient for chemical "i" (unitless)
 Intake_i = intake of chemical "i" (mg/kg/day) or exposure concentration_i (mg/kg)
 RfD_i = reference dose of chemical "i" (mg/kg/day) or benchmark value_i (mg/kg)

Potential adverse impacts were considered possible when the ratio of the contaminant intake (exposure concentration) to its respective RfD (benchmark value) exceeded unity. The HQ should not be construed as being probabilistic but rather as a numerical indicator of the extent to which a predicted intake (exposure concentration) exceeds or is less than an RfD (benchmark value). When the HQ exceed 1.0, it is an indication that ecological receptors are potentially at risk; additional data are necessary to confirm with greater certainty whether risk actually exists.

Receptor-specific Hazard Indices (HIs) are generated by summing the individual HQs for all the chemicals of concern. If the value of the HI exceeds unity, a potential risk to the receptors as a result of the combined exposure to these chemicals was also considered a possibility.

3.4.5.1 Calculating Hazard Quotients for Benthic and Aquatic Biota

Potential risks to benthic biota exposed to chemical present in onsite water bodies, the Thames River, and Goss Cove were assessed by comparing measured concentrations to background concentrations of these constituents (inorganics only), to surface water (Section 3.4.2.1) and sediment benchmark values (Section 3.4.2.2), and calculating HQs. A chemical was considered to represent a potential risk to aquatic biota if its exposure point concentration was greater than the background concentration and its HQ was greater than 1.0.

3.4.5.2 Calculating Hazard Quotients for Terrestrial Vegetation

Risks to terrestrial vegetation were determined by comparing concentrations of contaminants present in soil to conservative, phytotoxic benchmark values. The development of these values is described in Section 3.4.2.3.

The terrestrial plant risk assessment was based on the average and maximum (or UCL) measured soil concentrations detected at each site under consideration. Chemicals associated with a given site were considered to represent a potential risk to terrestrial vegetation if the HQs exceeded 1.0.

3.4.5.3 Calculating Hazard Quotients for Terrestrial Fauna

The following section summarizes methods used to calculate hazard quotients for soil invertebrates and terrestrial vertebrates.

Soil Invertebrates

Risks to soil invertebrates were determined by comparing concentrations of chemicals present in soil or in soil moisture to conservative benchmark values. The development of these values is described in Section 3.4.2.3 of this document. As was the case for all other media, the soil invertebrate risk assessment was based on the average and maximum (or UCL) measured soil chemical concentration detected at each site. Chemicals associated with a given site were considered to represent a potential risk to these receptors if the resulting HQs exceeded 1.0.

Terrestrial Vertebrates

Reference Doses (RfDs) were identified for each of the representative animal species selected to assess potential risks to ecological receptors inhabiting the NSB-NLON and the Thames River. Risk characterization was determined by generating a HQ. HQs were generated for each pathway (e.g., ingestion of water, incidental ingestion of soil, etc.) and chemical considered. Values greater than one are indicative of conditions that are likely to represent a potential risk to ecological receptors. If multiple contaminants of ecological concern are present at a given location, the HQs were summed to generate a Hazard Index. As was the case with HQs, HIs greater than 1.0 were interpreted to indicate that ecological receptors may be potentially at risk as a result of exposure to site contaminants.

Acute Risk to Terrestrial Vertebrates

In addition to the risk characterization for foodchain modeling based on chronic endpoints, acute potential risks were also assessed for terrestrial receptors. Acute HI values were calculated using maximum and average contaminant concentrations for those contaminants who contributed significantly to potential risks in the chronic modeling. The following formulas were used in the acute HI calculation:

$$\text{Chronic HI} = \text{Dose}/\text{NOAEL}$$

thus,

$$\text{Dose} = \text{Chronic HI} * \text{NOAEL}$$

The dose in the formula is assumed to also represent acute dose. Therefore, it was compared to acute threshold values obtained from several sources, including ECOTOX, AQUIRE, and TERRETOX databases. This results is an acute HI derivation as follows:

Acute HI = Dose/Acute Threshold

3.4.6 Uncertainties Analysis

Uncertainty is associated with all aspects of the BERA presented in the preceding sections. This section presents a summary of these uncertainties, with a discussion of how they may affect the final ecological risk values summarized in Sections 5.0 through 17.0.

The uncertainties and assumptions associated with the risk assessment must be taken into consideration when making risk management decisions. For instance, conservative estimates must be made to ensure that the exposure assumptions are protective of receptors inhabiting the impacted area. When conservative assumptions are combined, the resulting calculation will reflect the sum of the uncertainties associated with each assumption. This process results in an overprotection of risks.

As discussed in Section 3.3.5, the outcome of the risk assessment process is influenced by informational and measurement uncertainty.

These two types of uncertainty are associated with each of the steps of the ecological risk assessment process, including:

- uncertainty in the selection of ecological chemicals of concern results from the current knowledge and understanding of the toxicity of industrial chemicals to ecological receptors
- values used as input parameters for a given exposure route, and the methods used and the assumptions made to determine exposure point concentrations are associated with uncertainty
- uncertainty in the toxicity assessment includes the quality of dose-response data and values used to evaluate media-specific chemical concentrations

- uncertainty in risk characterization includes that associated with exposure to multiple chemicals and their potential synergistic, antagonistic, or additive effects.

The manner ("direction") in which uncertainty impacts the final predictions produced by this assessment (i.e., over or under prediction) is a function of the assumptions made throughout the risk assessment process. As noted above, conservative assumptions were made so that the final calculated risks would result in an overestimation of potential ecological risks attributable to NSB-NLON operations. Thus, uncertainty is associated with the degree to which the numerical values produced as a result of this process overestimate the actual risks.

3.4.6.1 Uncertainty in Selection of Chemicals of Concern

The selection of final COCs may increase the uncertainty associated with the final ecological receptor-specific risk values. Although a conservative, systematic, step-wise process was followed to identify these chemicals to be excluded from further evaluation, it is possible that species sensitive to these compounds may be present in this area and be adversely impacted. However, the likelihood that this scenario might occur is limited by the use of factors such as maximum concentrations, use of conservative benchmark values, and conservative exposure assumptions.

3.4.6.2 Uncertainty in the Exposure Assessment

The methods used to calculate exposure point concentrations, the selection of receptors and endpoints, and the selection of exposure parameters all contribute to uncertainty with respect to the exposure assessment. The direction of uncertainty can be estimated as follows:

- Exposure point concentrations (maximum):
 - surface water (Over predict)
 - sediments (Over predict)
 - soil (Over predict)
 - prey (Over predict)
- Receptors/Ecological Endpoints - Unknown
- Exposure pathway parameters - Unknown/over predict

Uncertainty Associated with Calculation of Exposure Point Concentrations

With the exception of prey, measured concentrations of chemicals were used as exposure point concentrations. Uncertainty with this aspect of the risk assessment arises from factors such as the degree to which the samples collected from a location are actually representative of site conditions and the uncertainty associated with the laboratory analyses used to quantify media-specific contaminant concentrations.

Empirically estimated or literature values of the organic carbon partition coefficients, octanol water partition coefficients, combined with soil exposure point concentrations were used in the estimation of contaminant concentrations in prey. The use of these parameters to determine the biological availability of chemicals present in soils and sediments and their subsequent movement through the food chain introduces additional uncertainty to the risk calculations. In several cases, information on a compound was limited and required the use of very conservative default values.

In addition, each time a concentration in one level of the food chain is extrapolated into a higher level, uncertainty is introduced into the result. For example, soil-to-invertebrate and invertebrate-to-predator biotransformation factors generally represent the maximum amount of contaminant transfer that may occur. In reality, the contaminant transfer is dependent on the form of the constituent, the physical and chemical characteristics of the soil, and the capacity of a particular species to incorporate a given chemical into tissue. Actual transfer factors for this site and these receptor organisms are not known. The selected methodologies are intended to be conservative, and more likely overestimate rather than underestimate tissue concentrations of chemicals.

Uncertainty in Selection of Representative Species

Unlike the human health risk assessment, the ecological risk assessment must consider risks to many different species. However, calculation of risk values for each potential receptor species is not possible. Impacts to surrogate or "representative" species are instead examined. The underlying assumptions associated with the use of surrogates is that impacts to these organisms will be indicative of potential impacts to actual receptors inhabiting the area. The choice of representative species for a given community is based on factors such as known sensitivity to the COCs, similarity of life history and behavior to other members of the community, importance in food chains, etc. However, species-specific physiological differences that may influence an organism's response to a chemical or subtle behavioral differences that

may increase/decrease a receptor's contact with a contaminant are seldom known. Use of surrogates, while necessary, will introduce uncertainty into the results of an assessment.

In addition to uncertainty regarding the degree to which risks to representative species reflect risks to other members of the community, uncertainty in the results of the risk assessment process arises when extrapolations are made across levels of ecological organization or from laboratory studies to field conditions. The uncertainty associated with extrapolations from results based on laboratory test conditions to field situations have long been acknowledged but remain difficult to quantify. In addition, the majority of the currently available toxicological data rests on the response of individuals exposed to chemicals. Extrapolations from these simple endpoints to more complex, ecologically relevant endpoints such as impacts to populations or communities also introduces uncertainty into the results of the risk assessment.

3.4.6.3 Selection of Exposure Parameters

Each exposure factor selected for use in this BERA has some associated uncertainty. For the most part, the availability of species-specific physiological measurements (e.g., water consumption) are limited and frequently must be estimated or extrapolated from the data collected from laboratory populations. While parameters more likely to result in an overestimation of risk were sought, the distribution of an attribute within a population is seldom known; therefore, the degree of conservatism introduced into the final estimation of potential risk remains similarly ill-defined. The following summarizes the potential impact that various exposure parameters might have had on the final determination of potential risks to ecological receptors.

Ingestion of Food Items

Contaminants present in soil may subsequently be biotransferred into soil invertebrate or mammals (i.e., shrew) tissue. Predators feeding on these prey organisms are eventually exposed to these chemicals. The parameters used to determine exposure to chemicals through ingestion of prey are summarized in Table 3-29.

Incidental Ingestion of Soil

Ecological receptors may be exposed to contaminants via incidental ingestion of contaminated soil. The parameters used to evaluate the incidental exposure to soil contaminants and their potential impact on the risk assessment are summarized in Table 3-30.

Ingestion of Water

Ecological receptors may be exposed to contaminants via ingestion of water. The parameters used to evaluate the exposure to surface water chemicals and their potential impact on the risk assessment are summarized in Table 3-31.

3.4.6.4 Uncertainty in the Toxicological Evaluation

Uncertainty associated with the toxicity assessment is a function of the hazard assessment which characterizes the degree of potential risk to ecological receptors and the dose-response evaluations which are indicative of potential adverse impacts resulting from exposure to chemicals.

Uncertainty in hazard assessment arises from the quality of the available toxicity data. This uncertainty is reduced when similar effects are observed among species exposed to the same chemical via the same exposure route and when the mechanisms of toxicity are similar for laboratory and wildlife species.

Uncertainty in the dose-response evaluation includes derivation of RfD values. Uncertainty is introduced from interspecies (animal to animal) as well as intraspecies (individual to individual) variation. Most toxicity experiments are performed with laboratory populations of animals so that variation is minimal. However, wildlife populations reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the chemical of concern. Uncertainty also arises as a result of the quality of the toxicity study used to derive the RfD.

Uncertainty factors were applied in the derivation of the RfD to account for differences among species. An uncertainty factor was also applied to estimate a no-effect level when lowest-effect levels were reported or when an RfD for chronic exposure was estimated from subchronic data (see Section 3.4.2.1).

3.4.6.5 Uncertainty in the Risk Characterization

Uncertainty in the risk characterization results from assumptions that concern the potential additivity or synergism that may occur when ecological receptors are exposed to multiple chemicals. Because data regarding the interaction of chemicals in the environment or within the body of the receptor are not well known, the impact of chemical interactions on the risk assessment process cannot be evaluated.

3.5 COMPARISON OF SITE DATA TO CONNECTICUT STANDARDS

Analytical data for the sites under investigation in the Phase II RI Report were compared to Connecticut drinking water standards (Title 19, Health and Safety, the Public Health Code of the State of Connecticut, Chapter II Environmental Health) and remediation standards (CTDEP, January 1996). The objective of the comparison is to identify, on a media-specific basis, those chemicals detected at concentrations in excess of state criteria. The results of the comparison will serve as the initial step towards determining compliance with state standards.

A brief discussion of media-specific state standards used in the comparison are provided in the remainder of this section.

3.5.1 Soil/Sediment

Site-specific data for soil and sediment were compared to Connecticut remediation standards for direct exposure and pollutant mobility. Depending on the likely anticipated land use, as determined based on conversations with the State, USEPA, and NAVY (October 25, 1995e), direct exposure criteria for residential or industrial exposure scenarios were employed. The migration of soil/sediment chemicals to groundwater was addressed via a comparison of site soil/sediment data to pollutant mobility criteria for GB classified areas.

3.5.2 Groundwater

For groundwater, Connecticut MCLs and remediation standards for groundwater and surface water protection were used. Filtered and unfiltered groundwater data were considered, if available. Although Connecticut MCLs were employed, it should be noted that groundwater at NSB-NLON is not currently used or expected to be used in the future as a potable water supply. A comparison of site data to remediation standards for groundwater and surface water protection was conducted because (1) as per the state

regulations, groundwater protection standards are used to protect existing groundwater regardless of the classification and (2) groundwater at the RI sites eventually discharges to a surface water body (i.e., the Thames River).

3.5.3 Surface Water

Site-specific surface water data were compared to Connecticut remediation standards for surface water protection. Filtered and unfiltered groundwater data were considered, if available.

In summary, discussions of the qualitative comparison of site data to Connecticut standards are presented in the site-specific sections. Tables summarizing the comparison are presented in the site-specific human health risk assessment appendices, following the quantitative risk assessment spreadsheets. Maximum and average chemical concentrations for the RI sites are presented in the summary tables.

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TABLE 3-1
SUMMARY OF REJECTED RESULTS
NSB-NLON, GROTON, CONNECTICUT
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Sample	Parameter *	Matrix	Sampling Round
1GW2S	TI (T/D)	GW	PH2-1
1GW2S-2	TI (T)	GW	PH2-2
011591-13MW14S	B (T)	GW	PH1
011591-13MW17S	B (T)	GW	PH1
011591-13MW27S	B (T)	GW	PH1
011591-13MW7S	B (T)	GW	PH1
011691-13MW1S	B (T)	GW	PH1
011691-13MW2S	B (T)	GW	PH1
011691-13MW3S	B (T)	GW	PH1
011791-13MW4S	B (T)	GW	PH1
011791-13MW5S	B (T)	GW	PH1
011791-13MW9S	B (T)	GW	PH1
011891-13MW10S	B (T)	GW	PH1
011891-13MW18S	B (T)	GW	PH1
011891-13MW6S	B (T)	GW	PH1
011891-NESOMW4S	B (T)	GW	PH1
012191-13MW11S	B, TI (T)	GW	PH1
012191-13MW12S	B, TI (T)	GW	PH1
012191-13MW13S	B, TI (T)	GW	PH1
012191-NESO11	B, TI (T)	GW	PH1
012191-NESOMW10S	B, Pb, TI (T)	GW	PH1
012191-NESOMW6S	B, TI (T)	GW	PH1
012291-13MW15S	B, Pb (T)	GW	PH1
012291-13MW19S	B, Pb (T)	GW	PH1
012291-WEMW1S	B, TI (T)	GW	PH1
012291-WEMW4S	B, TI (T)	GW	PH1
012391-13MW16S	B, Pb (T)	GW	PH1
012391-WEMW5S	B, TI (T)	GW	PH1
021191-13MW8	B (T)	GW	PH1
13GW11-2	TI (T)	GW	PH2-2
13GW13-2	Pb, Se, TI (D)	GW	PH2-2
13GW14-2	Sb, Se, TI (T)	GW	PH2-2
13GW15	Cu (T/D)	GW	PH2-1
13GW15-2	Sb, Cd, Se, TI (T)	GW	PH2-2
13GW16-2	Sb, Se, TI (T)	GW	PH2-2
13GW6-2	Pb, TI (D)	GW	PH2-2
13MW17-2	Pb, TI (D)	GW	PH2-2
13MW17D-2	Pb, Se, TI (D)	GW	PH2-2
13MW9-2	Pb (T/D); Pb, Se, TI (D)	GW	PH2-2
NES04-2	Pb, Se, TI (D)	GW	PH2-2
NES06-2	Pb, Se, TI (T/D)	GW	PH2-2
15GW1D-2	TI (T)	GW	PH2-2
15GW1D-D-2	TI (T)	GW	PH2-2
15GW1S-2	TI (T)	GW	PH2-2
15GW2S-2	TI (T)	GW	PH2-2

TABLE 3-1
SUMMARY OF REJECTED RESULTS
NSB-NLON, GROTON, CONNECTICUT
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Sample	Parameter *	Matrix	Sampling Round
15GW3S-2	TI (T)	GW	PH2-2
15GW4S-2	TI (T)	GW	PH2-2
010291-2DMW11S	B, TI (T)	GW	PH1
010291-3MW12S	SVs; B, TI (T)	GW	PH1
010391-2DMW16S	B, TI (T)	GW	PH1
010791-2DMW10D	B (T)	GW	PH1
010791-2DMW11D	B (T)	GW	PH1
010791-2DMW15D	B (T)	GW	PH1
010791-2DMW20D	B (T)	GW	PH1
010791-3MW12D	B (T)	GW	PH1
011491-2DMW16D	SVs; B (T)	GW	PH1
2DGW15D-D-2	Sb, Cd (T)	GW	PH2-2
2DGW16D	TI (T/D)	GW	PH2-1
2DGW16D-2	Pb, Se, TI (T)	GW	PH2-2
2DGW16S	As (T); TI (T/D)	GW	PH2-1
2DGW23D	TI (T/D)	GW	PH2-1
2DGW24D	Sd (T); TI (T/D)	GW	PH2-1
2DGW24D-2	Pb, Se, TI (T)	GW	PH2-2
2DGW24S	As (T); TI (T/D)	GW	PH2-1
2DGW25D-2	Pb, Se, TI (T)	GW	PH2-2
2DGW26D	TI (T/D)	GW	PH2-1
2DGW26D-D	As (T); TI (T/D)	GW	PH2-1
2DGW26S	As (T); TI (T/D)	GW	PH2-1
2DGW27D-2	TI (T)	GW	PH2-2
2DGW27S	As (T); TI (D)	GW	PH2-1
2DGW27S-2	TI (T)	GW	PH2-2
2DGW28D	As (T); TI (T/D)	GW	PH2-1
2DGW28D-2	TI (T)	GW	PH2-2
2DGW28S	As (T); TI (T/D)	GW	PH2-1
2DGW28S-2	TI (T)	GW	PH2-2
2DGW30S-2	Sb (T)	GW	PH2-2
010291-2LMW17S	B, TI (T)	GW	PH1
010291-2LMW9S	B, TI (T)	GW	PH1
010391-2LMW7S	B, TI (T)	GW	PH1
010891-2LMW17D	B (T)	GW	PH1
010891-2LMW21D	B (T)	GW	PH1
010891-2LMW7D	B (T)	GW	PH1
011091-2LMW13D	B (T)	GW	PH1
011091-2LMW9D	B (T)	GW	PH1
121390-2LMW18D	B (T)	GW	PH1
121390-2LMW18S	B (T)	GW	PH1
121390-2LMW19S	B (T)	GW	PH1
121490-2LMW8S	B (T)	GW	PH1
121790-2LMW14D	B (T)	GW	PH1
121790-2LMW8D	B (T)	GW	PH1

TABLE 3-1
SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
2LGW13D	Tl (T/D)	GW	PH2-1
2LGW13S	Sb (T)	GW	PH2-1
2LGW17D	Tl (T/D)	GW	PH2-1
2LGW17S	Tl (T/D)	GW	PH2-1
2LGW18D	Tl (T/D)	GW	PH2-1
2LGW18D-2	Tl (T)	GW	PH2-2
2LGW18S	Ag (T); Tl (T/D)	GW	PH2-1
2LGW18S-2	Sb, Cd, Cu, Tl (T)	GW	PH2-2
2LGW19D	Tl (T/D)	GW	PH2-1
2LGW7D	Tl (T/D)	GW	PH2-1
2LGW7S-2	Cd (T/D)	GW	PH2-2
2LGW8D	Tl (T/D)	GW	PH2-1
2LGW8D-2	Tl (T)	GW	PH2-2
2LGW9D	Tl (T/D)	GW	PH2-1
010291-2WMW6S	B, Tl (T)	GW	PH1
011191-2WMW3D	B (T)	GW	PH1
011491-2WMW2D	B (T)	GW	PH1
011591-2WMW1D	B (T)	GW	PH1
121190-2WMW3S	B (T)	GW	PH1
121490-2WMW5S	B (T)	GW	PH1
121890-2WMW6D	B (T)	GW	PH1
2WGW21D-2	N-nitroso-di-n-propylamine; Sb (T/D)	GW	PH2-2
2WGW21S	Sb (T/D); Cd (D)	GW	PH2-1
2WGW21S-2	Sb, Cd (T/D); Pb (D)	GW	PH2-2
2WGW3D	Sb, B (T)	GW	PH2-1
2WGW3D-2	Tl (T)	GW	PH2-2
2WGW3S	Sb (D)	GW	PH2-1
2WGW3S-2	Tl (T)	GW	PH2-2
2WGW5S	Sb (T)	GW	PH2-1
2WGW6D	Tl (T/D)	GW	PH2-1
2WGW6S	As (T); Tl (T/D)	GW	PH2-1
012491-2WMW4D	B, Pb, Tl (T)	GW	PH1
2WCGW1S-2	Sb, Cd (T)	GW	PH2-2
2WCGW3S-2	Sb (T); Cd (T/D)	GW	PH2-2
4GW2S	Tl (T/D)	GW	PH2-1
4GW3S	Tl (T/D)	GW	PH2-1
4GW4D	Tl (T/D)	GW	PH2-1
4GW4S	Tl (T/D)	GW	PH2-1
121790-6MW5D	B (T)	GW	PH1
121790-6MW5S	B (T)	GW	PH1
121890-6MW1S	B (T)	GW	PH1
121890-6MW2S	B (T)	GW	PH1
121890-6MW3S	B (T)	GW	PH1
121890-6MW4S	B (T)	GW	PH1
121890-6MW6S	B (T)	GW	PH1

TABLE 3-1
SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
6GW1S-2	Sb (T); Pb, Se, Tl (T/D)	GW	PH2-2
6GW2D	Sb, Cu, V (D)	GW	PH2-1
6GW2D-2	Pb, Se, Tl (T); V (T/D)	GW	PH2-2
6GW2S	Cu (D)	GW	PH2-1
6GW2S-2	Pb, Se, Tl (T); V (T/D)	GW	PH2-2
6GW3D	Sb (D); Cu (T); V (T/D)	GW	PH2-1
6GW3D-2	Sb, Tl (T)	GW	PH2-2
6GW3S	Sb, Cu (D)	GW	PH2-1
6GW3S-2	Cu (D); Pb, Se, Tl (T/D)	GW	PH2-2
6GW6S-2	Pb, Se, Tl (T)	GW	PH2-2
6GW7S-2	Sb, Tl (T)	GW	PH2-2
120690-7MW2	B (T)	GW	PH1
120690-7MW3	B (T)	GW	PH1
120790-7MW1	B (T)	GW	PH1
120790-7MW4	B (T)	GW	PH1
7GW1D-2	Sb (T/D)	GW	PH2-2
7GW2D-2	N-nitroso-di-n-propylamine; Sb (T/D)	GW	PH2-2
7GW2S-2	N-nitroso-di-n-propylamine; Sb (T/D)	GW	PH2-2
7GW6S-2	Sb (T/D)	GW	PH2-2
7GW7S-2	N-nitroso-di-n-propylamine; Sb (T/D)	GW	PH2-2
121890-8MW1S	B (T)	GW	PH1
121890-8MW2S	B (T)	GW	PH1
121890-8MW3S	B (T)	GW	PH1
121890-8MW4S	B (T)	GW	PH1
8GW1S-2	Cd (D)	GW	PH2-2
8GW1S-D-2	Cd (D)	GW	PH2-2
8GW2D	Sb (T)	GW	PH2-1
8GW2D-2	Cr (T)	GW	PH2-2
8GW5S	V (T)	GW	PH2-1
8GW5S-2	Cd (T)	GW	PH2-2
8GW5S-D	Sb, Cu, V (T)	GW	PH2-1
8GW6D	V (T)	GW	PH2-1
8GW6D-2	Cd (T/D); Cr (T)	GW	PH2-2
112990-3SD1(0-0.5)	Sb, B	SD	PH1
112990-3SD1(1-1.5)	Sb, B	SD	PH1
112990-3SD2(0-0.5)	Sb, B	SD	PH1
112990-3SD2(1-1.5)	Sb, B	SD	PH1
112990-3SD3(0-0.5)	Sb, B	SD	PH1
112990-3SD3(1-1.5)	Sb, B	SD	PH1
112990-3SD4(0-0.5)	Sb, B	SD	PH1
112990-3SD4(1-1.5)	Sb, B	SD	PH1
112990-3SD5(0-0.5)	Sb, B	SD	PH1
112990-3SD5(1-1.5)	Sb, B	SD	PH1
112990-3SD6(0-0.5)	Sb, B	SD	PH1
120390-2DSD1(0-0.5)	Sb, B	SD	PH1

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SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
120390-2DSD10(0-0.5)	Sb, B	SD	PH1
120390-2DSD11(0-0.5)	Sb, B	SD	PH1
120390-2DSD12(0-0.5)	Sb, B	SD	PH1
120390-2DSD2(0-0.5)	Sb, B	SD	PH1
120390-2DSD3(0-0.5)	Sb, B	SD	PH1
120390-2DSD4(0-0.5)	Sb, B	SD	PH1
120390-2DSD5(0-0.5)	Sb, B	SD	PH1
120390-2DSD6(0-0.5)	Sb, B	SD	PH1
120390-2DSD7(0-0.5)	Sb, B	SD	PH1
120390-2DSD8(0-0.5)	Sb, B	SD	PH1
120390-2DSD9(0-0.5)	Sb, B	SD	PH1
120790-2DSD13(0-0.5)	B	SD	PH1
120790-2DSD14(0-0.5)	B	SD	PH1
2DSD18 (0.0-1.0)	4,4'-DDD	SD	FFS
2DSD21 (0-1)	4,4'-DDD, dieldrin, endrin, hexachlorocyclopentadiene	SD	FFS
2DSD25 (1-3)	4,4'-DDD	SD	FFS
2DSD27 (0-1)	Hexachlorocyclopentadiene	SD	FFS
2DSD28 (0-1)	4,4'-DDD	SD	FFS
2DSD33 (0-1)	Hexachlorocyclopentadiene	SD	FFS
DUP-05	VOAs, SVs, PEST/PCBs, Sb, Be, Cd, CN, Hg, K, Se, Ag, TI	SD	ECO-2
DUP-06	PEST	SD	ECO-2
EC-SDLP10-2	PEST	SD	ECO-2
EC-SDLP11-2	VOAs, SVs, PEST/PCBs, Sb, As, Be, Cd, CN, Hg, Se, Ag	SD	ECO-2
EC-SDLP12-2	PEST	SD	ECO-2
EC-SDOP04-02	PEST	SD	ECO-2
EC-SDOP05-02	VOAs, SVs, PEST/PCBs, Sb, Cd, CN, Hg, Se, Ag, TI	SD	ECO-2
EC-SDOP06-02	PEST	SD	ECO-2
EC-SDS101-02	PEST	SD	ECO-2
EC-SDS102-02	PEST, Sb, Cd, CN, Hg, Se, Ag, Na, TI	SD	ECO-2
EC-SDS103-02	PEST	SD	ECO-2
EC-SDS207-02	PEST	SD	ECO-2
EC-SDS208-02	PEST	SD	ECO-2
EC-SDS209-02	VOAs, SVs, PEST/PCBs, Be, Cd, CN, Hg, K, Se, Ag, TI	SD	ECO-2
EC-SDS313-02	VOAs, SVs, PEST/PCBs, Sb, Cd, Hg, Se, TI	SD	ECO-2
EC-SDS315-02	PEST	SD	ECO-2
EC-SDS419-02	Dieldrin	SD	ECO-2
EC-SDUP16-02	Dieldrin, endosulfan sulfate, gamma-chlordane	SD	ECO-2
EC-SDUP17-02	PEST	SD	ECO-2
EC-SDUP18-02	VOAs, SVs, PEST/PCBs, Cd, Hg, Ag, TI	SD	ECO-2
112690-2WSD1(0-0.5)	Sb, B	SD	PH1

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SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
112690-2WSD10(0-0.5)	Sb , B	SD	PH1
112690-2WSD2(0-0.5)	Sb , B	SD	PH1
112690-2WSD3(0-0.5)	Sb , B	SD	PH1
112690-2WSD4(0-0.5)	Sb , B	SD	PH1
112690-2WSD5(0-0.5)	Sb , B	SD	PH1
112690-2WSD6(0-0.5)	Sb , B	SD	PH1
112690-2WSD7(0-0.5)	Sb , B	SD	PH1
112690-2WSD8(0-0.5)	Sb , B	SD	PH1
112690-2WSD9(0-0.5)	Sb , B	SD	PH1
DUP-5	PEST	SD	FFS
T1-A	4,4'-DDT, Hg	SD	FFS
T1-B	4,4'-DDD	SD	FFS
T10-B	4,4'-DDT	SD	FFS
T4-A	Hg	SD	FFS
T4-B	Hg	SD	FFS
T5-A	Hg	SD	FFS
T5-B	Hg	SD	FFS
T6-A	PEST, Hg	SD	FFS
T6-B	Endosulfan II	SD	FFS
T7-B	VOAs, SVs, PEST/PCBs, Sb, B, Hg, TI	SD	FFS
T8-A	4,4'-DDT	SD	FFS
T9-A	4,4'-DDT	SD	FFS
4SD1	Ag	SD	PH2-1
4SD2(1ST ROUND)	Ag	SD	PH2-1
120790-7SD1(0-0.5)	B	SD	PH1
8SD4	Ag	SD	PH2-1
EC-8SD3-02	VOAs, SVs, PEST/PCBs, Be, Ag	SD	ECO-2
DUP-04	VOAs, SVs, PEST/PCBs, Sb, As, Be, Cd, Co, CN, Hg, Se, Ag, TI	SD	ECO-2
EC-SDFB29-02	VOAs, SVs, PEST/PCBs, Sb, Cd, CN, Hg, K, Se, Ag, Na	SD	ECO-2
EC-SDNP22-2	PEST	SD	ECO-2
EC-SDNP23-2	VOAs, SVs, PEST/PCBs, Sb, As, Be, Cd, CN, Hg, Se, Ag, TI	SD	ECO-2
EC-SDNP24-2	PEST	SD	ECO-2
EC-SDPP26-02	VOAs, SVs, PEST/PCBs, Sb, CN, Hg, Ag, Na, TI	SD	ECO-2
EC-SDPP27-02	PEST/PCBs	SD	ECO-2
DUP-07	Endrin aldehyde	SD	ECO-2
EC-SDTR01-02	4-nitrophenol	SD	ECO-2
EC-SDTR02-02	4-Nitrophenol, Cd, Se, Ag, TI	SD	ECO-2
EC-SDTR03-02	Endrin aldehyde	SD	ECO-2
EC-SDTR04-02	Endrin aldehyde, Sb, Cd, Se, Ag, TI	SD	ECO-2
EC-SDTR05-02	Endrin aldehyde	SD	ECO-2
EC-SDTR06-02	Endrin aldehyde, Sb, Cd, Se, Ag, Hg	SD	ECO-2

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SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
EC-SDTR07-02	Hg	SD	ECO-2
EC-T3SD1-02	Endrin aldehyde	SD	ECO-2
EC-T3SD4-02	4-Nitrophenol, Sb, Be, Cd, Se, Ag	SD	ECO-2
EC-T4SD2-02	Endrin aldehyde	SD	ECO-2
T3SD3	2,4-Dinitrophenol, 4-nitrophenol	SD	PH2-1
T3SD4	2,4-Dinitrophenol, 4,6-dinitro-2-methylphenol	SD	PH2-1
T4SD3	2,4-Dinitrophenol, 4,6-dinitro-2-methylphenol	SD	PH2-1
T4SD4	2,4-Dinitrophenol, 4,6-dinitro-2-methylphenol	SD	PH2-1
T5SD3	2,4-Dinitrophenol, 4,6-dinitro-2-methylphenol	SD	PH2-1
T5SD4	2,4-Dinitrophenol, 4,6-dinitro-2-methylphenol	SD	PH2-1
T5SD4-D	2,4-Dinitrophenol, 4,6-dinitro-2-methylphenol	SD	PH2-1
083190-2WTB9(4-6)	B	SO	PH1
090690-2WTB9(4-6)	B	SO	PH1
13MW1(12-14)	B	SO	PH1
13MW10(6-8)	B	SO	PH1
13MW11(2-4)	B	SO	PH1
13MW12(8-10)	B	SO	PH1
13MW13(8-10)	B	SO	PH1
13MW14(12-14)	B	SO	PH1
13MW15(12-14)	B	SO	PH1
13MW16(10-12)	B	SO	PH1
13MW17(8-10)	B	SO	PH1
13MW2(10-12)	B	SO	PH1
13MW23(8-10)	B	SO	PH1
13MW24(12-14)	B	SO	PH1
13MW3(12-14)	B	SO	PH1
13MW4(6-8)	B	SO	PH1
13MW5(10-12)	B	SO	PH1
13MW6(14-16)	B	SO	PH1
13MW7(8-10)	B	SO	PH1
13MW8(8-10)	B	SO	PH1
13MW9(6-8)	B	SO	PH1
14MW1S-0002	Sb	SO	PH2-1
14SS3C-0-6	Sb	SO	PH1
14SS3C-0-6	B	SO	PH1
14TB1-0002	4-Nitrophenol	SO	PH2-1
14TB1-0810	4-Nitrophenol	SO	PH2-1
15TB19 (0.5-2.5)	Sb	SO	FFS
15TB3(4-8)	PEST/PCBs, Sb, B	SO	PH1
15TB6 (0-2)	Sb	SO	FFS
15TB7 (0-2)	Sb	SO	FFS
15TB8 (0.5-2.5)	PEST/PCBs	SO	FFS
15TB9 (0.5-2.5)	Sb	SO	FFS
1SS4C	Sb, B	SO	PH1
2DMW10S(3-5)	Sb, B	SO	PH1

TABLE 3-1
SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
2DMW11S(2-4)	Sb, B	SO	PH1
2DMW15(2-4)	Sb, B	SO	PH1
2DMW16(2-4)	Sb, B	SO	PH1
2LMW13(2-4)	B	SO	PH1
2LMW13(6-8)	B	SO	PH1
2LMW14S(5-7)	Sb, B, Ag	SO	PH1
2LMW17(0-2)	B	SO	PH1
2LMW17(4-8)	B	SO	PH1
2LMW18S(0-2)	B	SO	PH1
2LMW18S(2-6)	B	SO	PH1
2LMW19(0-4)	B	SO	PH1
2LMW33(2-4)	B	SO	PH1
2LMW7(7-10)	B	SO	PH1
2LMW8S(6-10)	Sb, B, Ag	SO	PH1
2LMW9(0-4)	B	SO	PH1
2LMW9(2-8)	B	SO	PH1
2LSS1	Sb, B	SO	PH1
2LSS2	Sb, B	SO	PH1
2LTB18 (0-2)	Hexachlorocyclopentadiene	SO	FFS
2LTB2(2-8)	B	SO	PH1
2WCMW3S-1618	4-Nitrophenol	SO	PH2-1
2WCMW3S-1618-D	4-Nitrophenol	SO	PH2-1
2WCTB4-0204	Sb	SO	PH2-1
2WCTB8-1012.6	4-Nitrophenol	SO	PH2-1
2WMW2(0-2)	B	SO	PH1
2WMW3(10-12)	B	SO	PH1
2WMW3(16-18)	B	SO	PH1
2WMW4(0-2)	Sb, B	SO	PH1
2WMW5(0-2)	B	SO	PH1
2WMW5(10-12)	B	SO	PH1
2WMW5(13)	B	SO	PH1
2WMW5(4-6)	B	SO	PH1
2WMW6(2-4)	Sb, B, Ag	SO	PH1
2WTB1(10-12)	B	SO	PH1
2WTB1(15-17)	B	SO	PH1
2WTB1(20-22)	B	SO	PH1
2WTB1(8-10)	B	SO	PH1
2WTB11(0-2)	B	SO	PH1
2WTB2(0-2)	B	SO	PH1
2WTB2(10-12)	B	SO	PH1
2WTB2(15-17)	B	SO	PH1
2WTB2(20-22)	B	SO	PH1
2WTB2(4-6)	B	SO	PH1
2WTB3(10-12)	B	SO	PH1

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SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
2WTB3(15-17)	B	SO	PH1
2WTB3(20-22)	B	SO	PH1
2WTB3(4-6)	B	SO	PH1
2WTB4(0-2)	B	SO	PH1
2WTB6(0-2)	4,4'-DDT, aldrin, B	SO	PH1
2WTB6(15-17)	B	SO	PH1
2WTB6(20-22)	B	SO	PH1
2WTB6(4-6)	B	SO	PH1
2WTB7(0-2)	B	SO	PH1
2WTB7(10-12)	B	SO	PH1
2WTB7(25-27)	B	SO	PH1
2WTB7(4-6)	B	SO	PH1
2WTB8(1-3)	B	SO	PH1
2WTB8(10-12)	B	SO	PH1
2WTB8(6-8)	B	SO	PH1
3MW12S(0-3)	B	SO	PH1
4SS3C	Sb, B	SO	PH1
4SS4	B	SO	PH2-1
6MW1(0-2)	Sb, B	SO	PH1
6MW1(4-6)	Sb, B	SO	PH1
6MW2(0-2)	B, Ag	SO	PH1
6MW2(2-4)	B	SO	PH1
6MW3(0-2)	Sb, B, Ag	SO	PH1
6MW3(2-4)	Sb, B, Ag	SO	PH1
6MW4(0-2)	B	SO	PH1
6MW4(2-4)	gamma-BHC, Sb, B	SO	PH1
6MW5S(0-2)	Sb, B	SO	PH1
6MW5S(8-10)	Sb, B	SO	PH1
6MW6(4-6)	Sb, B	SO	PH1
6SS1C	Sb, B	SO	PH1
6SS2C	Sb, B	SO	PH1
6SS3	Sb, B	SO	PH1
6SS4	Sb, B	SO	PH1
6SS5	Sb, B	SO	PH1
6TB1(0-2)	Sb, B	SO	PH1
6TB1(2-4)	Sb, B	SO	PH1
6TB10 (4-6)	SVs, Sb	SO	FFS
6TB11 (0-2)	Sb	SO	FFS
6TB12 (0-2)	Sb	SO	FFS
6TB16 (16-18)	Hg	SO	FFS
6TB17 (10-12)	Dieldrin	SO	FFS
6TB18 (0-1)	Sb	SO	FFS
6TB2(0-2)	Sb, B	SO	PH1
6TB2(2-4)	Sb, B	SO	PH1
6TB23 (0-1)	Sb	SO	FFS

TABLE 3-1
SUMMARY OF REJECTED RESULTS
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Sample	Parameter *	Matrix	Sampling Round
6TB3(0-2)	Sb, B	SO	PH1
6TB3(6-8)	Sb, B	SO	PH1
6TB4(0-2)	Sb, B	SO	PH1
6TB4(6-8)	Sb, B	SO	PH1
6TB5(0-2)	Pentachlorophenol, Sb, B	SO	PH1
6TB5(2-6)	SVs, Sb, B	SO	PH1
6TB6(0-2)	Sb, B	SO	PH1
6TB6(2-4)	Sb, B	SO	PH1
6TB7(0-2)	Sb, B	SO	PH1
6TB7(2-4)	Sb, B	SO	PH1
6TB8 (0-1)	Sb	SO	FFS
6TB8 (4-6)	Sb, Hg	SO	FFS
6TB8(0-2)	B	SO	PH1
6TB9 (2-4)	Sb	SO	FFS
7MW1(0-2)	B	SO	PH1
7MW2(2-4)	B	SO	PH1
7MW3(6-8)	B	SO	PH1
7MW9S-0608D	Sb	SO	PH2-1
7TB1(2-4)	B	SO	PH1
7TB12-0204	Sb	SO	PH2-1
7TB2(2-4)	B	SO	PH1
7TB3(4-6)	B	SO	PH1
7TB4(4-6)	B	SO	PH1
7TB5(6-8)	B	SO	PH1
7TB6(6-8)	B	SO	PH1
7TB7(2-4)	B	SO	PH1
8-SS02-03	Aroclor-1260	SO	PH2-3
8-SS03-03	Aroclor-1260	SO	PH2-3
8-SS03-03-D	4,4'-DDD, aroclor-1260	SO	PH2-3
8MW1(6-8)	Sb, B	SO	PH1
8MW2(10-12)	Endrin ketone, methoxychlor, B	SO	PH1
8MW2D-0103	B	SO	PH2-1
8MW3(8-10)	B	SO	PH1
8MW4(4-6)	B	SO	PH1
8MW5S-0103	Sb, B	SO	PH2-1
8MW6D-0406	B	SO	PH2-1
8MW7S-1416	B, Cd	SO	PH2-1
8TB1(4-6)	Sb, B	SO	PH1
8TB10-1820	Sb, B, Cd	SO	PH2-1
8TB14-1214	Sb, B	SO	PH2-1
8TB15-1113	Sb, B	SO	PH2-1
8TB2(6-8)	Sb, B	SO	PH1
8TB3(10-12)	4,4'-DDE, endrin ketone, methoxychlor, B	SO	PH1
8TB4(10-12)	B	SO	PH1
8TB7-0406	Sb, B, Cd, Na	SO	PH2-1

TABLE 3-1
SUMMARY OF REJECTED RESULTS
NSB-NLON, GROTON, CONNECTICUT
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Sample	Parameter *	Matrix	Sampling Round
8TB8-1012	Sb, B, Na	SO	PH2-1
8TB9-0406	B	SO	PH2-1
121090-2DSW1	B (T)	SW	PH1
121090-2DSW10	B (T)	SW	PH1
121090-2DSW11	B (T)	SW	PH1
121090-2DSW12	B (T)	SW	PH1
121090-2DSW13	B (T)	SW	PH1
121090-2DSW14	B (T)	SW	PH1
121090-2DSW2	B (T)	SW	PH1
121090-2DSW3	B (T)	SW	PH1
121090-2DSW4	B (T)	SW	PH1
121090-2DSW5	B (T)	SW	PH1
121090-2DSW6	B (T)	SW	PH1
121090-2DSW7	B (T)	SW	PH1
121090-2DSW8	B (T)	SW	PH1
121090-2DSW9	B (T)	SW	PH1
2DSW10	2-Hexanone, acetone; TI (T)	SW	PH2-1
2DSW11	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1
2DSW13	Ba, Cu (T)	SW	PH2-1
2DSW14	Hg (T)	SW	PH2-1
2DSW15	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1
2DSW2	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1
2DSW3	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1
2DSW30	2-Hexanone, acetone; TI (T)	SW	PH2-1
2DSW31	2-Hexanone, acetone; TI (T)	SW	PH2-1
2DSW32	2-Hexanone, acetone; TI (T)	SW	PH2-1
2DSW4	2-Hexanone; TI (T)	SW	PH2-1
2DSW5	2-Hexanone; Pb (T); TI (T/D)	SW	PH2-1
2DSW5D	2-Hexanone, acetone; Pb (T); TI (T/D)	SW	PH2-1
2DSW7	2-Hexanone; Pb, TI (T)	SW	PH2-1
2DSW9	2,4-Dinitrophenol, 2-hexanone, 4-nitrophenol, acetone, TI	SW	PH2-1
2DSW9D	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1
EC-SWLP12-2	alpha-Chlordane	SW	ECO-2
121090-2WSW1	B (T)	SW	PH1
121090-2WSW2	B (T)	SW	PH1
121090-2WSW3	B (T)	SW	PH1
2WSW1	TI (T/D)	SW	PH2-1
2WSW11	2-Hexanone, acetone; Pb (T); TI (T/D)	SW	PH2-1
2WSW12	2-Hexanone; Pb (T); TI (T/D)	SW	PH2-1
2WSW2	2-Hexanone; TI (T/D)	SW	PH2-1
2WSW6	Pb (D); TI (T/D)	SW	PH2-1
2WSW7	Hg (T)	SW	PH2-1
2WSW8	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1
2WSW9	2-Hexanone, acetone; Pb, TI (T)	SW	PH2-1

TABLE 3-1
SUMMARY OF REJECTED RESULTS
NSB-NLON, GROTON, CONNECTICUT
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Sample	Parameter *	Matrix	Sampling Round
4SW1	Hg (T)	SW	PH2-1
4SW2	Hg (T)	SW	PH2-1
4SW2-D	Hg (T)	SW	PH2-1
121090-6SW1	B (T)	SW	PH1
121190-7SW1	B (T)	SW	PH1
121090-8SW1	B (T)	SW	PH1
8SW2	Ba, Cu (T)	SW	PH2-1
8SW3	Ba, Cu (T)	SW	PH2-1
8SW4	Hg (T)	SW	PH2-1
8SW4-D	Hg (T)	SW	PH2-1
8SW5	Cu (T)	SW	PH2-1
8SW6	Cu (T)	SW	PH2-1
SW-01	TSS	SW	PH2-1
6SW1B	Ba (T); Cu (T/D); Na (D)	SW	PH2-1
6SW1S	Ba (T); Cu (T/D); Na (D)	SW	PH2-1
8SW1B	Ba (T); Cu (T/D); Na (D)	SW	PH2-1
8SW1S	Ba (T); Cu (T/D); Na (D)	SW	PH2-1
T3SW1AB	Ba, Cu (T)	SW	PH2-1
T3SW1AS	Ba (T); Cu (T/D); Na (D)	SW	PH2-1
T3SW1AS-D	Ba (T); Cu (T/D); Na (D)	SW	PH2-1
T3SW1BB	Ba, Cu (T)	SW	PH2-1
T3SW1BB-D	Ba, Cu (T)	SW	PH2-1
T3SW1BS	Ba, Cu (T)	SW	PH2-1
T3SW2B	Ba, Cu (T)	SW	PH2-1
T3SW2S	Ba, Cu (T)	SW	PH2-1
T3SW3B	Ba, Cu (T)	SW	PH2-1
T3SW3S	Ba, Cu (T)	SW	PH2-1
2DSS13WMDUP	PEST/PCBs	TIS	FFS
90 MBO 01	Ag, TI	TIS	PH1
90 MBO 02	Ag, TI	TIS	PH1
90 MBO 03	Ag, TI	TIS	PH1
90 MBO 04	Ag, TI	TIS	PH1
90 MBO 05	Ag, TI	TIS	PH1
90 MBO 06	Ag, TI	TIS	PH1
90 MBO 07	Ag, TI	TIS	PH1
90 MBO 08	Ag, TI	TIS	PH1
90 MBO 09	Ag, TI	TIS	PH1
90 MBO 10	Ag, TI	TIS	PH1
90 MBO 11	TI	TIS	PH1
90 MBO 12	TI	TIS	PH1
90 MBO 13	TI	TIS	PH1
90 MBO 14	TI	TIS	PH1
LOWER STR. 1 WHOLE FROG	Ag	TIS	PH1

TABLE 3-1
SUMMARY OF REJECTED RESULTS
NSB-NLON, GROTON, CONNECTICUT
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Sample	Parameter *	Matrix	Sampling Round
LOWER STREAM 2 MUSCLE	Ag	TIS	PH1
POND 1A MUSCLE	Ag	TIS	PH1
POND 1B MUSCLE	Ag	TIS	PH1
POND 1C MUSCLE	Ag	TIS	PH1
90 MBO 15	Tl	TIS	PH1
90 MBO 16	Tl	TIS	PH1
90 MBO 17	Tl	TIS	PH1
CMU1	2-Hexanone	TIS	ECO-1
CMU1-R	2-Hexanone, acetone	TIS	ECO-1
CMU1AVG	2-Hexanone	TIS	ECO-1
CMU2	2-Hexanone, 4,4'-DDT, endrin	TIS	ECO-1
CMU2-R	2-Hexanone, acetone	TIS	ECO-1
CMU2AVG	2-Hexanone	TIS	ECO-1
CMU3	2-Hexanone, 4,4'-DDT	TIS	ECO-1
CMU4	2-hexanone	TIS	ECO-1
CMU4-R	2-Hexanone, 4,4'-DDT	TIS	ECO-1
CMU4AVG	2-Hexanone	TIS	ECO-1
CMU5	2-Hexanone	TIS	ECO-1
CMU5-R	2-Hexanone	TIS	ECO-1
CMU5AVG	2-Hexanone	TIS	ECO-1
MU-C	2-Hexanone, 4,4'-DDT, endrin	TIS	ECO-1
MU-CD	2-Hexanone, endrin	TIS	ECO-1
MU-CDAVG	2-Hexanone, endrin	TIS	ECO-1

Matrix:

GW = Groundwater
SD = Sediment
SO = Soil
SW = Surface Water
TIS = Tissue

Parameter:

VOAs = Volatiles (used if some or all compounds were rejected)
SVs = Semivolatiles (used if some or all compounds were rejected).
PEST = Pesticides (used if some or all compounds were rejected)
PCBs = Polychlorinated biphenyls (used if some or all compounds were rejected)
T = Total matrix
D = Dissolved matrix
* Conventional abbreviations used for inorganic parameters.

Sampling Round:

PH1 = Phase I RI
PH2-1 = Phase II RI, Round 1
PH2-2 = Phase II RI, Round 2
FFS = Focused Feasibility Study
ECO-1 = Ecological Sampling, Round 1
ECO-2 = Ecological Sampling, Round 2

TABLE 3-2

**ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NSB-NLON, GROTON, CONNECTICUT**

Chemical	Specific Gravity (@ 20/4°C) ⁽²⁾	Vapor Pressure (mm Hg @ 20°C) ⁽²⁾	Solubility (mg/L @ 20°C) ⁽²⁾	Octanol/Water Partition Coefficient ⁽²⁾	Organic Carbon Partition Coefficient ⁽⁴⁾	Henry's Law Constant (atm- m ³ /mole) ⁽²⁾	Bioconcentration Factor (mg/L/mg/kg) ⁽⁴⁾
KETONES							
Acetone	0.7899	2.66E+2 (25°C)	Miscible	5.75E-1	5.37E+0 ⁽⁵⁾	4.276E-5 (25°C)	3.81E-1 ⁽⁸⁾
2-Butanone	0.8054	1.0E+2 (25°C)	2.75E+5	1.82E+0	4.44E+0 ⁽¹¹⁾	4.66E-5 (25°C)	9.3E-1 ⁽⁸⁾
4-Methyl-2-pentanone	0.7978 (20°C)	1.0E+1 (30°C)	1.91E+4	1.23E+1	5.30E+0 ⁽¹¹⁾	1.49E-5 (25°C)	3.9E+0 ⁽⁸⁾
2-Hexanone	0.8017 ⁽⁸⁾	6.0E+1 ⁽⁸⁾	3.5E+4	NA ⁽¹⁾	2.00E+0 ⁽¹¹⁾	1.75E-3(25°C)	2.5E+0 ⁽¹²⁾
MONOCYCLIC AROMATICS							
Benzene	0.8765	9.5E+1 (25°C)	1.78E+3	1.35E+2	6.5E+1	5.55E-3 (25°C)	3.7E+1
4-Chloroaniline	1.429 (19°C/4°C)	1.5E-2	3.9E+3	6.76E+1	NA	1.07E-5	NA
Chlorobenzene	1.1058	1.18E+1(25°C)	4.88E+2 (25°C)	6.92E+2	3.3E+2	3.93E-3 (25°C)	1.64E+2
4-Chloro-3-methylphenol	NA	5E-2	3.85E+3	1.26E+3	6.04E+2	2.5E-6	4E+2
2-Chlorophenol	1.2634	4.0E+1	2.85E+4	1.41E+2	7.3E+1	1.03E-5	4.1E+1
1,2-Dichlorobenzene	1.3048	1.5E+0 (25°C)	1.45E+2	2.4E+3	1.7E+3	2.951E-3	7.3E+2
1,3-Dichlorobenzene	1.2884	1.0E+0 (12.1°C)	1.23E+2 (25°C)	2.40E+3	1.7E+3	3.241E-3 (25°C)	7.3E+2
1,4-Dichlorobenzene	1.2475	1.8E+0 (30°C)	7.9E+1 (25°C)	2.45E+3	1.7E+3	4.328E-3 (25°C)	7.3E+2
2,4-Dichlorophenol	1.40 (15/4°C)	1E+0 (53°C)	4.5E+3 (25°C)	5.62E+2	3.8E+2	2.8E-6	1.86E+2
2,4-Dimethylphenol	0.965	9.8E+1 (104°C)	7.868E+3 (25°C)	2.63E+2	9.6E+1	6.55E-6 (25°C)	7.5E+1
4,6-Dinitro-2-methylphenol	NA	1.0E-4 (25°C)	1.3E+2	7.08E+2	2.4E+2	1.4E-6 (25°C)	1.22E+2
2,4-Dinitrotoluene	1.3208 (71°)	1.3E-3 (59°C)	2.7E+2 (22°C)	1.02E+2	4.5E+1	8.67E-7	3.9E+1
Ethylbenzene	0.867	1E+1 (25.9°C)	1.52E+2	1.41E+3	1.1E+3	8.043E-3 (25°C)	4.7E+2

TABLE 3-2 (Continued)
ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Specific Gravity (@ 20/4°C) ⁽²⁾	Vapor Pressure (mm Hg @ 20°C) ⁽²⁾	Solubility (mg/L @ 20°C) ⁽²⁾	Octanol/Water Partition Coefficient ⁽²⁾	Organic Carbon Partition Coefficient ⁽⁴⁾	Henry's Law Constant (atm- m ³ /mole) ⁽²⁾	Bioconcentration Factor (mg/L/mg/kg) ⁽⁴⁾
2-Methylphenol	1.0273	2.4E-1 (25°C)	3.1E+4 (40°C)	8.91E+1	1.8E+1 ⁽¹⁰⁾	8.41E-7	1.8E+1 ⁽⁸⁾
4-Methylphenol	1.0178	1.1E-1 (25°C)	2.4E+4 (40°C)	8.32E+1	9.0E-1 ⁽¹⁰⁾	3.92E-7	1.7E+1 ⁽⁸⁾
2-Nitroaniline	1.442 (15°C)	< 1.0E-1	1.26E+3 (25°C)	6.76E+1	8.6E+1 ⁽¹¹⁾	9.72E-5 (25°C)	1.4E+1
4-Nitrophenol	1.479	2.2E+0 (146°C)	1.6E+4 (25°C)	8.13E+1	4.5E+1	3E-5	2.7E+1
Pentachlorophenol	1.978 (22/4°C)	1.1E-4	1.4E+1	1.02E+5	5.3E+4	2.8E-6	1.6E+4
Phenol	1.0576	3.5E-1 (25°C)	8E+4 (25°C)	2.88E+1	1.42E+1	1.3E-6 (25°C)	9.4E+0
Styrene	0.9060	5E+0	3E+2	1.44E+3	1.89E+2 ⁽¹¹⁾	2.633E-3 (25°C)	1.48E+2 ⁽⁸⁾
Toluene	0.8669	2.8E+1 (25°C)	5.15E+2	4.9E+2	3.0E+2	5.92E-3 (25°C)	1.48E+2
1,2,4-Trichlorobenzene	1.4542	1.0E+0 (38.4°C)	1.9E+1 (22°C)	9.55E+3	9.2E+3	1.42E-3 (25°C)	3.3E+3
Xylenes (Total)	0.86104 - 0.8801	1E+1 (27.3 - 32.1°C)	1.6E+2 - 1.75E+2 ⁽⁸⁾	5.89E+2 - 1.58E+3	4.77E+1 - 2.6E+2 ⁽⁸⁾	4.184E-3 - 6.662E-3 (25°C)	7.5E+1 - 1.59E+2 ⁽⁸⁾

HALOGENATED ALIPHATICS

Bromodichloromethane	1.98	5E+1	4.5E+3 (0°C)	7.59E+1	6.1E+1	2.12E-3 (25°C)	3.5E+1
Bromoform	2.8899	5.6E+0 (25°C)	3.2E+3(30°C)	2.0E+2	1.16E+2	5.32E-4 (25°C)	6.3E+1
Bromomethane	1.6755	1.42E+3	1.75E+4	1.26E+1	5.9E+0	2E-1	4.2E+0
Chloroethane	0.8978	1.011E+3	5.74E+3	2.69E+1	1.49E+1	6.919E-3	9.8E+0
Chloroform	1.4832	1.60E+2	9.3E+3 (25°C)	9.33E+1	4.4E+1	3.39E-3 (25°C)	2.6E+1
Chloromethane	0.9159	3.8E+3	6.36E+3	8.13E+0	4.3E+0	8.82E-3 (24.8°C)	3.2E+0
1,1-Dichloroethane	1.1757	2.34E+2 (25°C)	5.5E+3	1.67E+1	3.0E+1	5.871E-3 (25°C)	1.9E+1
1,2-Dichloroethane	1.2351	7.9E+1 (25°C)	8.69E+3	2.82E+1	1.4E+1	1.178E-3 (25°C)	9E+0
1,1-Dichloroethene	1.218	5.91E+2 (25°C)	2.1E+2 (25°C)	3.02E+1	6.5E+1	2.286E-2 (25°C)	5.3E+1
cis-1,2-Dichloroethene	1.2837	2.02E+2 (25°C)	8E+2	NA	1.1E+2 ⁽¹¹⁾	4.08E-3 (24.8°C)	1.4E+1 ⁽³⁾

TABLE 3-2 (Continued)
ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Specific Gravity (@ 20/4 °C) ⁽²⁾	Vapor Pressure (mm Hg @ 20 °C) ⁽²⁾	Solubility (mg/L @ 20 °C) ⁽²⁾	Octanol/Water Partition Coefficient ⁽²⁾	Organic Carbon Partition Coefficient ⁽⁴⁾	Henry's Law Constant (atm- m ³ /mole) ⁽²⁾	Bioconcentration Factor (mg/L/mg/kg) ⁽⁴⁾
trans-1,2-Dichloroethene	1.2565	3.31E+2 (25°C)	6E+2	3.02E+1	5.9E+1	6.673E-3 (25°C)	4.8E+1
1,2-Dichloropropane	1.156	4.2E+1	2.7E+3	1.9E+2	5.1E+1	2.675E-3 (25°C)	3E+1
cis-1,3-Dichloropropene	1.217	4.3E+1	2.7E+3	2.57E+1	4.8E+1	3.55E-3	4E+1
trans-1,3-Dichloropropene	1.224	3.4E+1	2.8E+3	2.57E+1	4.8E+1	3.55E-3	4E+1
Methylene chloride	1.3266	4.29E+2 (25°C)	1.67E+4 (25°C)	1.78E+1	8.8E+0	3.19E-3 (25°C)	6E+0
1,1,2,2-Tetrachloroethane	1.5953	4E+0 (25°C)	2.9E+3	2.45E+2	1.18E+2	3.8E-4	9.1E+1
Tetrachloroethene	1.6227	1.9E+1 (25°C)	1.5E+2 (25°C)	3.39E+2	3.64E+2	2.685E-2 (25°C)	2.52E+2
1,1,1-Trichloroethane	1.339	1E+2	4.4E+3	2.95E+2	1.52E+2	4.08E-3 (25°C)	8.1E+1
1,1,2-Trichloroethane	1.4397	2.5E+1 (25°C)	4.5E+3	1.48E+2	5.6E+1	9.607E-4 (25°C)	3.3E+1
Trichloroethene	1.4642	7.7E+1 (25°C)	1.1E+3 (25°C)	3.39E+2	1.26E+2	1.17E-2 (25°C)	9.7E+1
Vinyl chloride	0.9106	2.58E+3	1.1E+3 (25°C)	3.98E+0	1.7E+1	2.78E-2 (25°C)	5.7E+0

HALOGENATED ETHERS

4-Bromophenyl phenyl ether	1.4208	1.5E-3	3.3E+0 (25°C) ⁽⁴⁾	1.91E+4	5.8E+4	1E-4	1.8E+4
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MISCELLANEOUS VOLATILE ORGANICS

Carbon disulfide	1.2632	2.98E+2	2.9E+3	1.45E+2	5.4E+1 ⁽¹¹⁾	1.921E-2 (25°C)	2.6E+1 ⁽⁸⁾
Vinyl acetate	0.9317	1E+2 (25°C)	2E+4	5.37E+0	1.88E+1 ⁽¹¹⁾	4.81E-4	2.1E+0 ⁽⁸⁾

POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)

Acenaphthene	1.0242 (90/4°C)	1E+1 (131°C)	3.42E+0 (25°C)	8.32E+3	4.6E+3	2.41E-4 (25°C)	1.8E+3
Acenaphthylene	0.8988 (16/2°C)	2.9E-2	3.93E+0 (25°C)	1.17E+4	2.5E+3	1.14E-4 (25°C)	1E+3
Anthracene	1.283 (25/4°C)	1.95E-4 (25°C)	1.29E+0 (25°C)	2.82E+4	1.4E+4	8.6E-5 (25°C)	4.7E+3
Benzo(a)anthracene	1.274	5E-9	1E-2 (24°C)	4.07E+5	2E+5	6.6E-7	5.3E+4

TABLE 3-2 (Continued)
ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Specific Gravity (@ 20/4°C) ⁽²⁾	Vapor Pressure (mm Hg @ 20°C) ⁽²⁾	Solubility (mg/L @ 20°C) ⁽²⁾	Octanol/Water Partition Coefficient ⁽²⁾	Organic Carbon Partition Coefficient ⁽⁴⁾	Henry's Law Constant (atm- m ³ /mole) ⁽²⁾	Bioconcentration Factor (mg/L/mg/kg) ⁽⁴⁾
Benzo(b)fluoranthene	NA	5E-7	1.2E-3 (25°C)	3.72E+6	5.5E+5	1.2E-5	1.4E+5
Benzo(k)fluoranthene	NA	9.59E-11	5.5E-4 (25°C)	6.92E+6	5.5E+5	1.04E-3	1.4E+5
Benzo(g,h,i)perylene	NA	1E-10	2.6E-4 (25°C)	1.7E+7	1.6E+6	1.4E-7 (25°C)	3.5E+5
Benzo(a)pyrene	1.351	5E-9	3.8E-3 (25°C)	9.55E+5	5.5E+6	4.9E-7 (25°C)	1.4E+5
Chrysene	1.274 (20°C)	6.3E-9 (25°C)	6E-3 (25°C)	4.07E+5	2.0E+5	1.05E-6 (25°C)	5.3E+4
Dibenz(a,h)anthracene	1.282	1E-10	5E-4 (25°C)	9.33E+5	3.3E+6	7.3E-8 (25°C)	6.9E+5
Fluoranthene	1.252	5.0E-6 (25°C)	2.65E-1 (25°C)	2.14E+5	3.8E+4	6.5E-6 (25°C)	1.2E+4
Fluorene	1.202	1E+1 (146°C)	1.9E+0 (25°C)	1.51E+4	7.3E+3	1.17E-4 (25°C)	3.8E+3
Indeno(1,2,3-cd)pyrene	NA	1E-10 (25°C)	6.2E-2	4.57E+7	1.6E+6	6.95E-8 (25°C)	3.5E+5
2-Methylnaphthalene	1.0058	1E+1 (105°C)	2.6E+1 (25°C)	7.24E+3	7.27E+2 ⁽¹¹⁾	4.99E-4 (25°C)	5.1E+2 ⁽⁸⁾
Naphthalene	1.162	8.2E-2 (25°C)	3E+1 (25°C)	2.34E+3	9.4E+2	4.83E-4 (25°C)	4.2E+2
Phenanthrene	0.980 (4°C)	1E+0 (118.2°C)	8.16E-1 (21°C)	2.88E+4	1.4E+4	3.93E-5 (25°C)	4.7E+3
Pyrene	1.271 (23/4°C)	2.5E+0 (200°C)	1.6E-1 (26°C)	1.51E+5	3.8E+4	5.1E-6 (25°C)	1.2E+4

PHTHALATE ESTERS

Bis(2-ethylhexyl)phthalate	0.99 (20/20°C)	1.2E+0 (200°C)	4E-1 (25°C)	2E+5	2E+9	3E-7	2.3E+8
Butylbenzylphthalate	1.1 (25/25°C)	8.6E-6	2.9E+0	6.03E+4	1.7E+5	8.3E-6 ⁽⁴⁾	4.7E+4
Di-n-butylphthalate	1.047 (20/20°C)	1E-1 (115°C)	4E+2 (25°C)	1.58E+5	1.7E+5	2.8E-7 (25°C)	4.7E+4
Diethylphthalate	1.1175	5E-2 (70°C)	1.08E+3 (25°C)	9.12E+2	1.42E+2	8.46E-7	1.07E+2
Dimethylphthalate	1.1905	< 1E-2	5E+3	7.41E+1	1.74E+1	4.2E-7	1.6E+1
Di-n-octylphthalate	0.978	< 2E-1 (150°C)	3E+0 (25°C)	1.58E+9	3.6E+9	1.41E-12 (25°C)	3.9E+8

TABLE 3-2 (Continued)
ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Specific Gravity (@ 20/4°C) ⁽²⁾	Vapor Pressure (mm Hg @ 20°C) ⁽²⁾	Solubility (mg/L @ 20°C) ⁽²⁾	Octanol/Water Partition Coefficient ⁽²⁾	Organic Carbon Partition Coefficient ⁽⁴⁾	Henry's Law Constant (atm- m ³ /mole) ⁽²⁾	Bioconcentration Factor (mg/L/mg/kg) ⁽⁴⁾
NITROGEN CONTAINING CHEMICALS							
3,3'-Dichlorobenzidine	NA	4.2E-7 (25°C)	3.1E+0 (25°C)	3.23E+3	1.553E+3	4.5E-8 (25°C)	9.41E+2
N-Nitrosodiphenylamine	NA	1E-1	3.5E+1	6.16E+2	6.48E+2	3.13E+0	4.26E+2
MISCELLANEOUS SEMIVOLATILE ORGANICS							
Benzoic acid	1.27 ⁽⁸⁾	NA	2.9E+3 ⁽⁸⁾	7.41E+1 ⁽⁸⁾	5.4E+1 ⁽¹¹⁾	NA	1.55E+1 ⁽⁸⁾
Benzyl alcohol	1.0419 (24°C/24°C)	1.5E-1 (25°C)	3.5E+4	1.26E+1	1.4E+1 ⁽¹¹⁾	NA	4E+0 ⁽⁸⁾
Carbazole	1.1 (18°C/4°C)	4.0E+2 (323°C)	NA	1.95E+3 ⁽⁸⁾	NA	NA	1.86E+2 ⁽⁸⁾
Dibenzofuran	1.0886 (99°C/4°C)	NA	1E+1	1.32E+4	1.23E+3 ⁽¹¹⁾	NA	7.97E+2 ⁽⁸⁾
Isophorone	0.9229 (20°C)	3.8E-1	1.2E+4	5.01E+1	8.7E+1	5.8E-6	4.8E+1
PESTICIDES							
Aldrin	1.7	2.3E-5	1.7E-2 (25°C)	1.288E+5	9.6E+4	4.96E-4 (25°C)	2.8E+4
alpha-BHC	1.87	6E-2 (40°C)	1.63E+0 (25°C)	6.46E+3	3.8E+3	5.3E-6	1.5E+3
beta-BHC	1.89 (19°C)	1.7E-1 (40°C)	7E-1 (25°C)	6.31E+3	3.8E+3	2.3E-7	1.5E+3
delta-BHC	1.87	2E-2	2.13E+1 (25°C)	1.38E+4	6.6E+3	2.5E-7	3.5E+3
gamma-BHC (Lindane)	1.891 (19°C/14°C)	9.4E-6	7E+0	1.74E+3	3.8E+3	4.93E-7 (25°C)	1.5E+3
Chlordane	1.61 (25°C)	1E-5 (25°C)	5.6E-2	6.03E+2	1.4E+5	4.79E-5 (25°C)	4.0E+4
4,4'-DDD	1.476	1E-6 (30°C)	1.6E-1 (24°C)	9.77E+5	7.7E+5	2.16E-5	1.8E+5
4,4'-DDE	NA	6.5E-6	4E-2	4.9E+5	4.4E+6	2.34E-5	8.9E+5
4,4'-DDT	1.5 (15/4°C)	1.5E-7	3.1E-3 (25°C)	1.55E+6	3.9E+6	3.89E-5 (25°C)	8E+6
Dieldrin	1.75	1.8E-7 (25°C)	1.86E-1	1.23E+4	1.7E+3	5.84E-5 (25°C)	7.1E+2
Endosulfan I	1.745	1E-5 (25°C)	3.2E-1 (22°C)	3.55E+3	9.6E-3	1.01E-4 (25°C)	1.2E-2

TABLE 3-2 (Continued)
ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Specific Gravity (@ 20/4°C) ⁽²⁾	Vapor Pressure (mm Hg @ 20°C) ⁽²⁾	Solubility (mg/L @ 20°C) ⁽²⁾	Octanol/Water Partition Coefficient ⁽²⁾	Organic Carbon Partition Coefficient ⁽⁴⁾	Henry's Law Constant (atm- m ³ /mole) ⁽²⁾	Bioconcentration Factor (mg/L/mg/kg) ⁽⁴⁾
Endosulfan II	1.745 (20/20°C)	1E-5 (25°C)	3.3E-1 (22°C)	4.17E+3	9.6E-3	1.91E-5 (25°C)	1.2E-2
Endosulfan sulfate	NA	1E-5 (25°C) ⁽⁴⁾	2.2E-1	4.57E+3	2.4E-2	2.6E-5 (25°C)	2.9E-2
Endrin	1.65 (25°C/4°C)	2E-7 (25°C)	2.6E-1 (25°C)	3.98E+5	1.7E+3	4E-7 (25°C)	7.1E+2
Endrin aldehyde	NA	2E-7 (25°C)	2.6E-1 (25°C)	3.98E+5	6.7E+2	3.86E-7 (25°C)	3.1E+2
Endrin ketone	NA	NA	NA	NA	NA	NA	NA
Heptachlor	1.57 (9°C)	3E-4 (25°C)	5.6E-2 (25°C)	2.51E+4	1.2E+4	1.48E-3	4.4E+3
Heptachlor epoxide	NA	2.6E-6	3.5E-1 (25°C)	4.47E+3	2.2E+2	3.16E-5 (25°C)	1.1E+2
Methoxychlor	1.41 (25°C)	1.4E-6 (25°C) ⁽⁷⁾	4E-2 (24°C)	4.79E+4	7.94E+4 ⁽⁷⁾	1.6E-5 (25°C) ⁽⁷⁾	2.12E+3 ⁽⁸⁾

PCBs

Aroclor-1016	NA	4E-4 (25°C) ⁽⁴⁾	4.2E-1 (25°C) ⁽⁴⁾	3.8E+5 ⁽⁴⁾	1.8E+5	3.3E-4 ⁽⁴⁾	5.0E+4
Aroclor-1242	NA	1.3E-3 (25°C) ⁽⁴⁾	2.3E-1 (25°C) ⁽⁴⁾	1.3E+4 ⁽⁴⁾	6.3E+3	1.98E-3 ⁽⁴⁾	2.3E+3
Aroclor-1248	1.41 (25°C) ⁽⁴⁾	4.94E-4 ⁽⁴⁾	5.4E-2 ⁽⁴⁾	5.75E+5 ⁽⁴⁾	2.77E+5	3.6E-3 ⁽⁴⁾	7.29E+4
Aroclor-1254	1.50 (25°C) ⁽⁴⁾	7.71E-5 ⁽⁴⁾	3.1E-2 ⁽⁴⁾	1.1E+6 ⁽⁴⁾	5.3E+5	2.6E-3 ⁽⁴⁾	1.3E+5
Aroclor-1260	1.58 (25°C) ⁽⁴⁾	4.05E-5 ⁽⁴⁾	2.7E-3 ⁽⁴⁾	1.4E+7 ⁽⁴⁾	6.7E+6	7.4E-1 ⁽⁴⁾	1.3E+6

- 1 NA - Not Available.
- 2 USEPA, September 1992i.
- 3 Lyman et al., 1990; Equation 5-3.
- 4 USEPA, December 1982.
- 5 ATSDR, October 1992a.
- 6 ATSDR, October 1989a.
- 7 ATSDR, October 1992b.
- 8 Lyman et al., 1990, Eq. 5-2.
- 9 Verschueren, 1983.
- 10 Howard, 1989.
- 11 Lyman et al., 1990; Equation 4-5.

TABLE 3-3
ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR INORGANICS
NSB-NLON, GROTON, CONNECTICUT

Element	Molecular Weight (g/mole)	Soil/Water Distribution Coefficient (Kd) ⁽¹⁾ (mL/g)	Bioconcentration Factor ⁽²⁾ (L/kg)
Antimony	121.75	NR ⁽³⁾	NR
Arsenic	74.92	1.0 - 8.3	44
Barium	137.34	NR	NR
Beryllium	9.01	NR	NR
Boron	10.81	NR	NR
Cadmium	112.4	1.3 - 27	64
Chromium III	52.0	470 - 150,000	16
Cobalt	58.93	0.2 - 3,800	NR
Copper	63.54	1.4 - 333	36
Lead	207.19	4.5 - 7,640	NR
Manganese	54.93	0.2 - 10,000	NR
Mercury	200.59	NR	NR
Nickel	58.71	NR	NR
Selenium	78.96	1.2 - 8.6	4.8
Silver	107.87	10 - 1,000	0.5
Thallium	204.37	NR	116
Vanadium	50.94	NR	NR
Zinc	65.38	0.1 - 8,000	47

- 1 Dragun, 1988.
- 2 USEPA, 1991f.
- 3 NR - Not reported.

TABLE 3-4
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - AQUEOUS MEDIA
NSB-NLON, GROTON CONNECTICUT
PAGE 1 OF 4

Chemical	Media (1)		Groundwater & Surface Water COC Screening Level (2) (mg/L)	Groundwater				Surface Water	
				Drinking Water Standards		State Remediation Standards (5)		Federal AWQC (6)	State AWQC (7)
	GW	SW		Federal MCL/MCLG (3) (mg/L)	State MCL (4) (mg/L)	Groundwater Protection (mg/L)	Surface Water Protection (mg/L)	Consumption of Organisms/Water & Organisms (mg/L)	Consumption of Organisms/Water & Organisms (mg/L)
1,1,1-Trichloroethane	X	ND	0.13	0.2 / 0.2	0.2	0.2	62	170 / 3.1	- / 3.1
1,1,2,2-Tetrachloroethane	X	ND	5.2E-5	NA	NA	5E-4	0.11	0.011 / 1.7E-4	0.011 / 1.7E-4
1,1,2-Trichloroethane	X	X	1.9E-4	0.005 / 0.003	0.005	0.005	1.26	0.042 / 6.0E-4	0.042 / 6E-4
1,1-Dichloroethane	X	ND	0.081	NA	NA	0.07	NA	NA	NA
1,1-Dichloroethene	X	ND	4.4E-5	0.007 / 0.007	0.007	0.007	0.096	0.0032 / 5.7E-5	0.0032 / 5.7E-5
1,2-Dichloroethane	X	ND	1.2E-4	0.005 / 0	0.005	0.001	2.97	0.099 / 3.8E-4	0.099 / 3.8E-4
1,2-Dichloroethene (total)	X	ND	0.0055 (8)	0.07 / 0.07 (9) 0.1 / 0.1 (10)	0.07 (9) 0.1 (10)	0.07 (9) 0.1 (10)	NA	140 / 0.7 (10)	NA
2-Butanone	X	ND	0.19	NA	NA	0.4	NA	NA	NA
2-Hexanone	X	ND	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	X	ND	0.29	NA	NA	0.35	NA	NA	NA
Acetone	X	ND	0.37	NA	NA	0.7	NA	NA	NA
Benzene	X	ND	3.6E-4	0.005 / 0	0.005	0.001	0.71	0.071 / 0.0012	0.071 / 0.0012
Bromodichloromethane	X	X	1.7E-4	0.1 / 0 (24)	0.1 (24)	NA	NA	0.022 / 2.7E-4	0.022 / 2.7E-4
Carbon disulfide	X	X	0.1	NA	NA	NA	NA	NA	NA
Chlorobenzene	X	ND	0.0039	0.1 / 0.1	0.1	0.1	420	21 / 0.68	21 / 0.68
Chloroform	X	X	1.5E-4	0.1 / 0 (24)	0.1 (24)	0.006	14.1	0.47 / 0.0057	0.47 / 0.0057
Chloromethane	X	ND	0.0014	NA	NA	NA	NA	NA	NA
Dibromochloromethane	ND	X	1.3E-4	0.1 / 0 (24)	0.1 (24)	5E-4	1.02	0.034 / 4.1E-4	0.034 / 4.1E-4
Ethylbenzene	X	X	0.13	0.7 / 0.7	0.7	0.7	580	29 / 3.1	29 / 3.1
Methylene chloride	X	X	0.0041	0.005 / 0	0.005	0.005	48	1.6 / 0.0047	1.6 / 0.0047
Styrene	X	X	0.16	0.1 / 0.1	0.1	0.1	NA	NA	NA
Tetrachloroethene	X	X	0.0011	0.005 / 0	0.005	0.005	0.088	0.00885 / 8E-4	0.00885 / 8E-4
Toluene	X	X	0.075	1 / 1	1	1	4000	200 / 6.8	200 / 6.8
Trans-1,3-dichloropropene	ND	X	7.7E-5 (11)	NA	NA	5E-4 (11)	34 (11)	1.7 / 0.01 (11)	1.7 / 0.01 (11)
Trichloroethene	X	X	0.0016	0.005 / 0	0.005	0.005	2.34	0.081 / 0.0027	0.081 / 0.0027
Vinyl chloride	X	ND	1.9E-5	0.002 / 0	0.002	0.002	15.75	0.525 / 0.002	0.525 / 0.002
Xylenes (total)	X	X	1.2 (12)	10 / 10	10	0.53	NA	NA	NA
1,2,4-Trichlorobenzene	X	ND	0.019	0.07 / 0.07	0.07	NA	NA	NA	NA
1,2-Dichlorobenzene	X	ND	0.027	0.6 / 0.6	0.6	0.6	170	17 / 2.7	17 / 2.7
1,3-Dichlorobenzene	X	ND	0.054	0.6 / 0.6	NA	0.6	26	2.6 / 0.4	2.6 / 0.4
1,4-Dichlorobenzene	X	ND	4.4E-4	0.075 / 0.075	0.075	0.075	26	2.6 / 0.4	2.6 / 0.4
2,4-Dichlorophenol	X	ND	0.011	NA	NA	0.02	15.8	0.79 / 0.093	0.79 / 0.093
2,4-Dimethylphenol	X	ND	0.073	NA	NA	NA	NA	2.3 / 0.54	NA

TABLE 3-4
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - AQUEOUS MEDIA
NSB-NLON, GROTON CONNECTICUT
PAGE 2 OF 4

Chemical	Media (1)		Groundwater & Surface Water COC Screening Level (2) (mg/L)	Groundwater				Surface Water	
	GW	SW		Drinking Water Standards		State Remediation Standards (5)		Federal AWQC (6) Consumption of Organisms/Water & Organisms (mg/L)	State AWQC (7) Consumption of Organisms/Water & Organisms (mg/L)
				Federal MCL/MCLG (3) (mg/L)	State MCL (4) (mg/L)	Groundwater Protection (mg/L)	Surface Water Protection (mg/L)		
2,4-Dinitrotoluene	X	ND	0.0073	NA	NA	NA	NA	0.0091 / 1.1E-4	0.0091 / 1.1E-4
2-Chlorophenol	X	ND	0.018	NA	NA	0.036	NA	0.4 / 0.12	NA
2-Methylnaphthalene	X	ND	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol	X	ND	0.18	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether	X	ND	0.21	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	X	ND	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	X	ND	0.018	NA	NA	NA	NA	NA	NA
Acenaphthene	X	ND	0.22	NA	NA	NA	NA	2.7 / 1.2	NA
Acenaphthylene	X	ND	NA	NA	NA	0.42	3E-4	NA	3.1E-5 / 2.8E-6
Anthracene	X	ND	1.1	NA	NA	2	1100	110 / 9.6	110 / 9.6
Benzo(a)anthracene	X	ND	9.2E-5	NA	NA	6E-5	3E-4	3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
Benzo(a)pyrene	X	ND	9.2E-6	2E-4 / 0	2E-4	2E-4	3E-4	3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
Benzo(b)fluoranthene	X	ND	9.2E-5	NA	NA	8E-5	3E-4	3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
Benzo(g,h,i)perylene	X	ND	NA	NA	NA	NA	NA	3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
Benzo(k)fluoranthene	X	ND	9.2E-4	NA	NA	5E-4	3E-4	NA	3.1E-5 / 2.8E-6
Benzoic acid	X	ND	15	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	X	X	0.0048	0.006 / 0	0.006	0.002	0.059	0.0059 / 0.0018	0.0059 / 0.0018
Butylbenzylphthalate	X	X	0.73	NA	NA	1	NA	5.2 / 3	NA
Carbazole	X	ND	0.0034	NA	NA	NA	NA	NA	NA
Chrysene	X	ND	0.0092	NA	NA			3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
Di-n-butylphthalate	X	X	0.37	NA	NA	0.7	120	12 / 2.7	12 / 2.7
Di-n-octylphthalate	X	X	0.073	NA	NA	0.1	NA	NA	NA
Dibenzo(a,h)anthracene	X	ND	9.2E-6	NA	NA	NA	NA	3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
Dibenzofuran	X	ND	0.015	NA	NA	NA	NA	NA	NA
Diethylphthalate	X	X	2.9	NA	NA	NA	NA	120 / 23	120 / 23
Dimethylphthalate	X	ND	37	NA	NA	NA	NA	2900 / 313	2900 / 313
Fluoranthene	X	ND	0.15	NA	NA	0.28	3.7	0.37 / 0.3	0.37 / 0.3
Fluorene	X	ND	0.15	NA	NA	0.28	140	14 / 1.3	14 / 1.3
Indeno(1,2,3-cd)pyrene	X	ND	9.2E-5	NA	NA	NA	NA	3.11E-5 / 2.8E-6	3.1E-5 / 2.8E-6
N-Nitrosodiphenylamine	X	ND	0.014	NA	NA	NA	NA	0.016 / 0.005	0.016 / 0.005
Naphthalene	X	ND	0.15	NA	NA	0.28	NA	NA	NA
Phenanthrene	X	ND	NA	NA	NA	0.2	7.7E-5	NA	3.1E-5 / 2.8E-6
Phenol	X	ND	2.2	NA	NA	4	9.2E+4	4600 / 21	4600 / 21
Pyrene	X	ND	0.11	NA	NA	0.2	110	11 / 0.96	11 / 0.96

TABLE J-4
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - AQUEOUS MEDIA
NSB-NLON, GROTON CONNECTICUT
PAGE 3 OF 4

Chemical	Media (1)		Groundwater & Surface Water COC Screening Level (2) (mg/L)	Groundwater				Surface Water	
	GW	SW		Drinking Water Standards		State Remediation Standards (5)		Federal AWQC (6)	State AWQC (7)
				Federal MCL/MCLG (3) (mg/L)	State MCL (4) (mg/L)	Groundwater Protection (mg/L)	Surface Water Protection (mg/L)	Consumption of Organisms/Water & Organisms (mg/L)	Consumption of Organisms/Water & Organisms (mg/L)
4,4'-DDD	ND	X	2.8E-4	NA	NA	NA	NA	8.4E-7 / 8.3E-7	8.4E-7 / 8.3E-7
4,4'-DDE	ND	X	2E-4	NA	NA	NA	NA	5.9E-7 / 5.9E-7	5.9E-7 / 5.9E-7
4,4'-DDT	ND	X	2E-4	NA	NA	NA	NA	5.9E-7 / 5.9E-7	5.9E-7 / 5.9E-7
Aroclor-1016	X	ND	2.6E-4	5E-4 / 0 (25)	5E-4 (25)	5E-4 (25)	5E-4 (25)	4.5E-8 / 4.4E-8 (25)	4.5E-8 / 4.4E-8 (25)
Aroclor-1254	X	ND	7.3E-5	5E-4 / 0 (25)	5E-4 (25)	5E-4 (25)	5E-4 (25)	4.5E-8 / 4.4E-8 (25)	4.5E-8 / 4.4E-8 (25)
Aroclor-1260	X	ND	8.7E-6	5E-4 / 0 (25)	5E-4 (25)	5E-4 (25)	5E-4 (25)	4.5E-8 / 4.4E-8 (25)	4.5E-8 / 4.4E-8 (25)
Endrin aldehyde	ND	X	NA	NA	NA	NA	NA	8.1E-4 / 7.6E-4	8.1E-4 / 7.6E-4
Heptachlor	X	X	2.3E-6	4E-4 / 0	4E-4	4E-4	5E-5	2.1E-7 / 2.1E-7	2.1E-7 / 2.1E-7
Aluminum	X	X	3.7	0.05 - 0.2 (13)	NA	NA	NA	NA	NA
Antimony	X	ND	0.0015	0.006 / 0.006	0.006	0.006	86	4.3 / 0.014	4.3 / 0.014
Arsenic	X	X	4.5E-5	0.05 / -	0.05	0.05	0.004	1.4E-4 / 1.8E-5	0.00014 / 1.8E-5
Barium	X	X	0.26	2 / 2	2	1	NA	NA	NA
Beryllium	X	ND	1.6E-5	0.004 / 0.004	0.004	0.004	0.004	1.3E-4 / 7.7E-6	1.3E-4 / 7.7E-6
Boron	X	X	0.33	NA	NA	NA	NA	NA	NA
Cadmium	X	X	0.0018	0.005 / 0.005	0.005	0.005	0.006	0.17 / 0.016	0.17 / 0.016
Calcium	X	X	NA	NA	NA	NA	NA	NA	NA
Chromium	X	X	0.018 (14)	0.1 / 0.1 (15)	0.1 (15)	0.05 (15)	1.2 (16) 0.11 (14)	670 / 33 (16) 3.4 / 0.17 (14)	670 / 33 (16) 3.4 / 0.17 (14)
Cobalt	X	X	0.22	NA	NA	NA	NA	NA	NA
Copper	X	X	0.15	1.3 / 1.3 (17)	NA	1.3	0.048	- / 1.3	NA
Cyanide	X	X	0.073 (17)	0.2 / 0.2	0.2	0.2	0.052	215 / 0.7	220 / 0.7
Iron	X	X	1.1	0.3 (13)	NA	NA	NA	NA	NA
Lead	X	X	0.015 (16)	0.015 / 0 (17)	NA	0.015	0.013	- / 0.05	- / 0.05
Magnesium	X	X	NA	NA	NA	NA	NA	NA	NA
Manganese	X	X	0.018	0.05 (13)	5 (19)	NA	NA	NA	NA
Mercury	X	X	0.0011	0.002 / 0.002	0.002	0.002	4E-4	1.5E-4 / 1.4E-4	1.5E-4 / 1.4E-4
Nickel	X	X	0.073	0.1 / 0.1	0.1	0.1	0.88	4.6 / 0.61	4.6 / 0.61
Potassium	X	X	NA	NA	NA	NA	NA	NA	NA
Selenium	X	X	0.018	0.05 / 0.05	0.05	0.05	0.05	6.8 / 0.1	6.8 / 0.1
Silver	X	X	0.018	0.1 (13)	0.05	0.036	0.012	65 / 0.105 (20)	65 / 0.105
Sodium	X	X	NA	NA	28 (21)	NA	NA	NA	NA
Thallium	X	ND	2.6E-4 (22)	0.002 / 5E-4	0.002	0.005	0.063	0.0063 / 0.0017	0.0063 / 0.0017
Vanadium	X	X	0.026	NA	NA	0.05	NA	NA	NA

TABLE 3-4
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - AQUEOUS MEDIA
NSB-NLON, GROTON CONNECTICUT
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Chemical	Media (1)		Groundwater & Surface Water COC Screening Level (2) (mg/L)	Groundwater				Surface Water	
				Drinking Water Standards		State Remediation Standards (5)		Federal AWQC (6)	State AWQC (7)
				Federal MCL/MCLG (3) (mg/L)	State MCL (4) (mg/L)	Groundwater Protection (mg/L)	Surface Water Protection (mg/L)	Consumption of Organisms/Water & Organisms (mg/L)	Consumption of Organisms/Water & Organisms (mg/L)
Zinc	X	X	1.1	5 (13)	NA	5	0.123	NA	NA
TPH	X	ND	0.5 (23)	NA	NA	0.5	NA	NA	NA

- 1 X - Indicates that chemical was detected in this medium.
 - 2 For residential tap water ingestion, based on current USEPA Region III guidance (USEPA Region III, October 1995e).
 - 3 Maximum Contaminant Level/Maximum Contaminant Level Goal (USEPA, May 1995c).
 - 4 Title 19, Health and Safety, the Public Health Code of the State of Connecticut, Chapter II Environmental Health.
 - 5 CTDEP, January 1996.
 - 6 Ambient Water Quality Criteria (USEPA, 1986).
 - 7 Connecticut Water Quality Standards, 1992.
 - 8 1,2-Dichloroethene (mixture).
 - 9 Cis-1,2-dichloroethene.
 - 10 Trans-1,2-dichloroethene.
 - 11 1,3-Dichloropropene (total).
 - 12 Xylenes (mixture).
 - 13 Secondary MCL, based on aesthetic drinking water qualities.
 - 14 Chromium (hexavalent).
 - 15 Chromium (total).
 - 16 Chromium (trivalent).
 - 17 Action Level.
 - 18 Hydrogen cyanide.
 - 19 Current Connecticut Department of Public Health and Addiction Services Action Level.
 - 20 Values for acute exposure; criteria for chronic exposure not available.
 - 21 Notification Level.
 - 22 Thallic oxide.
 - 23 CTDEP remediation standard for groundwater protection used to qualitatively identify TPH as a COC.
 - 24 Total for trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane).
 - 25 Total PCBs (sum of all Aroclors).
- ND - Not Detected
NA - Not Available

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TABLE 3-5
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - SOLID MEDIA
NSB-NLON, GROTON, CONNECTICUT
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Chemical	Media (1)		COC Screening Level (2)		Soil/Sediment				
	Soil/ Sed	Fish	Soil/Sediment (mg/kg)	Finfish/Shellfish (mg/kg)	USEPA SSLs (3)			State Remediation Standards (4)	
					Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	Residential/ Industrial Direct Exposure (mg/kg)	GA(GAA)/GB Pollutant Mobility (mg/kg)
1,1,1-Trichloroethane	X	ND	700	12	NA	980	0.9	500 / 1000	4 / 40
1,1,2,2-Tetrachloroethane	X	ND	3.2	0.016	3	0.4	0.001	3.1 / 29	0.01 / 0.1
1,1,2-Trichloroethane	X	X	11	0.055	11	0.8	0.01	11 / 100	0.1 / 1
1,1-Dichloroethane	X	ND	780	14	7800	980	11	500 / 1000	1.4 / 14
1,1-Dichloroethene	X	ND	1.1	0.0053	1	0.04	0.03	1 / 9.5	0.14 / 1.4
1,2-Dichloroethane	X	ND	7	0.035	7	0.3	0.01	6.7 / 63	0.02 / 0.2
1,2-Dichloroethene (total)	X	ND	70 (5)	1.2 (5)	780 (6) 1600 (7)	1500 (6) 3600 (7)	0.2 (6) 0.3 (7)	500 / 1000 (6) 500 / 1000 (7)	1.4 / 14 (6) 2 / 20 (7)
1,2-Dichloropropane	X	ND	9.4	0.046	9	11	0.02	9 / 84	0.1 / 1.0
2-Butanone	X	X	4700	81	NA	NA	NA	500 / 1000	8 / 80
2-Hexanone	X	ND	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	X	ND	630	11	NA	NA	NA	500 / 1000	7 / 14
Acetone	X	X	780	14	7800	6.2E+4	8	500 / 1000	14 / 140
Benzene	X	X	22	0.11	22	0.5	0.02	21 / 200	0.02 / 0.2
Bromodichloromethane	X	X	10	0.051	5	1800	0.3	NA	NA
Bromoform	X	ND	81	0.4	81	46	0.5	78 / 720	0.08 / 0.8
Bromomethane	X	ND	11	0.19	110	2	0.1	NA	NA
Carbon disulfide	X	X	780	14	7800	11	14	NA	NA
Chlorobenzene	X	ND	160	2.7	1600	94	0.6	500 / 1000	2 / 20
Chloroethane	X	ND	3100	54	NA	NA	NA	NA	NA
Chloroform	X	X	100	0.52	110	0.2	0.3	100 / 940	0.12 / 1.2
Chloromethane	X	ND	49	0.24	NA	NA	NA	NA	NA
Cis-1,3-dichloropropene	X	ND	3.7 (8)	0.018 (8)	4 (8)	0.1 (8)	0.001 (8)	3.4 / 32 (8)	0.01 / 0.1 (8)
Dibromochloromethane	ND	X	7.6	0.038	8	1900	0.2	7.3 / 68	0.01
Ethylbenzene	X	X	780	14	7800	260	5	500 / 1000	10.1 / 10.1
Methylene chloride	X	X	85	0.42	85	7	0.01	82 / 760	0.1 / 1.0
Styrene	X	X	1600	27	1.6E+4	1400	2	500 / 1000	2 / 20
Tetrachloroethene	X	X	12	0.061	12	11	0.04	12 / 110	0.1 / 1
Toluene	X	X	1600	27	1.6E+4	520	5	500 / 1000	20 / 67
Trans-1,3-dichloropropene	X	X	3.7 (8)	0.018 (8)	4 (8)	0.1 (8)	0.001 (8)	3.4 / 32 (8)	0.01 / 0.1 (8)
Trichloroethene	X	X	58	0.29	58	3	0.02	56 / 520	0.1 / 1
Vinyl acetate	X	ND	7800	140	7.8E+4	370	84	NA	NA

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TABLE 3-5
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - SOLID MEDIA
NSB-NLON, GROTON, CONNECTICUT
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Chemical	Media (1)		COC Screening Level (2)		Soil/Sediment				
	Soil/ Sed	Fish	Soil/Sediment (mg/kg)	Finfish/Shellfish (mg/kg)	USEPA SSLs (3)			State Remediation Standards (4)	
					Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	Residential/ Industrial Direct Exposure (mg/kg)	GA(GAA)/GB Pollutant Mobility (mg/kg)
Vinyl chloride	X	ND	0.34	0.0017	0.3	0.002	0.01	0.32 / 3	0.04 / 0.4
Xylenes (total)	X	X	1.6E+4 (9)	270 (9)	1.6E+5	320	74	500 / 1000	19.5 / 19.5
1,2,4-Trichlorobenzene	X	ND	78	1.4	780	240	2	NA	NA
1,3-Dichlorobenzene	X	ND	700	12	NA	NA	NA	5000 / 1000	12 / 120
1,4-Dichlorobenzene	X	ND	27	0.13	27	7700	1	26 / 240	1.5 / 15
2,4-Dimethylphenol	X	ND	160	2.7	1600		3	NA	NA
2-Methylnaphthalene	X	X	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol	X	X	390	6.8	3900	NA	6	NA	NA
2-Nitroaniline	X	ND	0.47	0.0081	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	X	ND	1.4	0.007	1	NA	0.01	NA	NA
4,6-Dinitro-2-methylphenol	X	ND	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	X	ND	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	X	ND	31	0.54	310	NA	0.3	NA	NA
4-Methylphenol	X	ND	39	0.68	NA	NA	NA	NA	NA
4-Nitrophenol	X	ND	480	8.4	NA	NA	NA	NA	NA
Acenaphthene	X	X	470	8.1	4700	NA	200	NA	NA
Acenaphthylene	X	ND	NA	NA	NA	NA	NA	1000 / 2500	8.4 / 84
Anthracene	X	ND	2300	41	2.3E+4	NA	4300	1000 / 2500	40 / 400
Benzo(a)anthracene	X	ND	0.88	0.0043	0.9	NA	0.7	1 / 7.8	1 / 1
Benzo(a)pyrene	X	ND	0.088	4.3E-4	0.09	NA	4	1 / 1	1 / 1
Benzo(b)fluoranthene	X	ND	0.88	0.0043	0.9	NA	4	1 / 7.8	1 / 1
Benzo(g,h,i)perylene	X	ND	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	X	ND	8.8	0.043	9	NA	4	8.4 / 78	1 / 1
Benzoic acid	X	X	3.1E+4	540	3.1E+5	NA	280	NA	NA
Benzyl alcohol	ND	X	2300	41	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	X	X	46	0.23	46	210	11	44 / 410	1 / 11
Butylbenzylphthalate	X	X	1600	27	1.6E+4	530	68	1000 / 2500	20 / 200
Carbazole	X	ND	32	0.16	32	NA	0.2	NA	NA
Chrysene	X	ND	88	0.43	88	NA	1	NA	NA
Di-n-butylphthalate	X	X	780	14	7800	100	120	1000 / 2500	14 / 140
Di-n-octylphthalate	X	X	160	2.7	1600	NA	NA	1000 / 2500	2 / 20
Dibenzo(a,h)anthracene	X	ND	0.088	4.3E-4	0.09	NA	11	NA	NA
Dibenzofuran	X	X	31	0.54	NA	NA	NA	NA	NA

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TABLE J-5
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - SOLID MEDIA
NSB-NLON, GROTON, CONNECTICUT
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Chemical	Media (1)		COC Screening Level (2)		Soil/Sediment				
	Soil/ Sed	Fish	Soil/Sediment (mg/kg)	Finfish/Shellfish (mg/kg)	USEPA SSLs (3)			State Remediation Standards (4)	
					Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	Residential/ Industrial Direct Exposure (mg/kg)	GA(GAA)/GB Pollutant Mobility (mg/kg)
Diethylphthalate	X	X	6300	110	6.3E+4	520	110	NA	NA
Dimethylphthalate	X	ND	7.8E+4	1400	7.8E+5	1600	1200	NA	NA
Fluoranthene	X	X	310	5.4	3100	NA	980	1000 / 2500	5.6 / 56
Fluorene	X	X	310	5.4	3100	NA	160	1000 / 2500	5.6 / 56
Indeno(1,2,3-cd)pyrene	X	ND	0.88	0.0043	0.9	NA	35	NA	NA
Isophorone	X	ND	670	3.3	670	3400	0.2	NA	NA
N-Nitrosodiphenylamine	X	ND	130	0.64	130	NA	0.2	NA	NA
Naphthalene	X	X	310	5.4	3100	NA	30	1000 / 2500	5.6 / 56
Pentachlorophenol	X	ND	5.3	0.026	3	NA	0.01	5.1 / 48	1 / 1
Phenanthrene	X	X	NA	NA	NA	NA	NA	1000 / 2500	4 / 40
Phenol	X	ND	4700	81	4.7E+4	NA	49	1000 / 2500	80 / 800
Pyrene	X	X	230	4.1	2300	NA	1400	1000 / 2500	4 / 40
4,4'-DDD	X	X	2.7	0.013	3	NA	0.7	NA	NA
4,4'-DDE	X	X	1.9	0.0093	2	NA	0.5	NA	NA
4,4'-DDT	X	X	1.9	0.0093	2	80	1	NA	NA
Aldrin	X	X	0.038	1.9E-4	0.04	0.5	0.005	NA	NA
Alpha-BHC	X	X	0.1	5E-4	0.1	0.9	4E-4	NA	NA
Alpha-chlordane	X	ND	0.49 (10)	0.0024 (10)	0.5 (10)	10 (10)	2 (10)	0.49 / 2.2 (10)	0.066 / 0.066 (10)
Aroclor-1242	X	ND	0.083	4.1E-4	1	NA	NA	1 / 10 (19)	1E-4 / 0.005 (20)
Aroclor-1248	X	ND	0.083	4.1E-4	1	NA	NA	1 / 10 (19)	1E-4 / 0.005 (20)
Aroclor-1254	X	ND	0.16	0.0027	1	NA	NA	1 / 10 (19)	1E-4 / 0.005 (20)
Aroclor-1260	X	ND	0.083	4.1E-4	1	NA	NA	1 / 10 (19)	1E-4 / 0.005 (20)
Beta-BHC	X	X	0.35	0.0018	0.4	16	0.002	NA	NA
Delta-BHC	X	ND	NA	NA	NA	NA	NA	NA	NA
Dieldrin	X	X	0.04	2E-4	0.04	2	0.001	0.038 / 0.36	0.007 / 0.007
Endosulfan I	X	ND	47 (11)	0.81 (11)	470	NA	4	NA	NA
Endosulfan II	X	ND	47 (11)	0.81 (11)	470	NA	4	NA	NA
Endosulfan sulfate	X	ND	NA	NA	NA	NA	NA	NA	NA
Endrin	X	ND	2.3	0.041	23	NA	0.04	20 / 610	NA
Endrin aldehyde	X	X	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	X	ND	NA	NA	NA	NA	NA	NA	NA
Gamma-BHC	X	X	0.49	0.0024	0.5	NA	0.006	20 / 610	0.02 / 0.04

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TABLE 3-5
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - SOLID MEDIA
NSB-NLON, GROTON, CONNECTICUT
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Chemical	Media (1)		COC Screening Level (2)		Soil/Sediment				
					USEPA SSLs (3)			State Remediation Standards (4)	
	Soil/ Sed	Fish	Soil/Sediment (mg/kg)	Finfish/Shellfish (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	Residential/ Industrial Direct Exposure (mg/kg)	GA(GAA)/GB Pollutant Mobility (mg/kg)
Gamma-chlordane	X	X	0.49 (10)	0.0024 (10)	0.5 (10)	10 (10)	2 (10)	0.49 / 2.2 (10)	0.066 / 0.066 (10)
Heptachlor	X	X	0.14	7E-4	0.1	0.3	0.06	0.14 / 1.3	0.013 / 0.013
Heptachlor epoxide	X	X	0.07	3.5E-4	0.07	1	0.03	0.067 / 0.63	0.02 / 0.02
Methoxychlor	X	ND	39	0.68	390	NA	62	340 / 1E+4	0.8 / 8
1,2,3,4,6,7,8-HPCDD	X	ND	4E-4 (12)	NA	NA	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDF	X	ND	4E-4 (12)	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-HXCDF	X	ND	4E-5 (12)	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-HXCDF	X	ND	4E-5 (12)	NA	NA	NA	NA	NA	NA
2,3,7,8-TCDF	X	ND	4E-5 (12)	NA	NA	NA	NA	NA	NA
OCDD	X	ND	0.004 (12)	NA	NA	NA	NA	NA	NA
OCDF	X	ND	0.004 (12)	NA	NA	NA	NA	NA	NA
Aluminum	X	X	7800	140	NA	NA	NA	NA	NA
Antimony	X	ND	3.1	0.054	31	NA	NA	27 / 8200	0.006 / 0.06 (20)
Arsenic	X	X	0.43	0.0021	0.4	380	15	10 / 10	0.05 / 0.5 (20)
Barium	X	X	550	9.5	5500	3.5E+5	32	4700 / 1.4E+5	1 / 10.0 (20)
Beryllium	X	ND	0.15	7.3E-4	0.1	690	180	2 / 2	0.004 / 0.04 (20)
Boron	X	X	700	12	NA	NA	NA	NA	NA
Cadmium	X	X	3.9	0.068	39	920	6	34 / 1000	0.005 / 0.05 (20)
Calcium	X	X	NA	NA	NA	NA	NA	NA	NA
Chromium	X	X	39 (13)	0.68 (13)	390 (13)	140 (13)	19 (13)	3900 / 5.1E+4 (14) 100 / 100 (13)	0.05 / 0.5 (20)(21)
Cobalt	X	X	470	8.1	NA	NA	NA	NA	NA
Copper	X	X	310	5.4	NA	NA	NA	2500 / 7.6E+4	1.3 / 13 (20)
Cyanide	X	X	160 (15)	2.7 (15)	1600	NA	NA	1400 / 4.1E+4	0.2 / 2 (20)(22)
Iron	X	X	2300	41	NA	NA	NA	NA	NA
Lead	X	X	400 (16)	NA	400	NA	NA	500 / 1000	0.015 / 0.15 (20)
Magnesium	X	X	NA	NA	NA	NA	NA	NA	NA
Manganese	X	X	39	0.68	NA	NA	NA	NA	NA
Mercury	X	X	2.3	0.041	23	7	3	20 / 610	0.002 / 0.02 (20)
Nickel	X	X	160	2.7	1600	6900	21	1400 / 7500	0.1 / 1.0 (20)
Potassium	X	X	NA	NA	NA	NA	NA		NA
Selenium	X	X	39	0.68	390	NA	3	340 / 1E+4	0.05 / 0.5 (20)

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TABLE J-5
RISK-BASED COC SCREENING LEVELS AND OTHER HEALTH-BASED STANDARDS - SOLID MEDIA
NSB-NLON, GROTON, CONNECTICUT
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Chemical	Media (1)		COC Screening Level (2)		Soil/Sediment				
	Soil/ Sed	Fish	Soil/Sediment (mg/kg)	Finfish/Shellfish (mg/kg)	USEPA SSLs (3)			State Remediation Standards (4)	
					Ingestion (mg/kg)	Inhalation (mg/kg)	Migration to Groundwater (mg/kg)	Residential/ Industrial Direct Exposure (mg/kg)	GA(GAA)/GB Pollutant Mobility (mg/kg)
Silver	X	X	39	0.68	390	NA	NA	340 / 1E+4	0.036 / 0.36 (20)
Sodium	X	X	NA	NA	NA	NA	NA	NA	NA
Thallium	X	ND	0.55 (17)	0.0095 (17)	NA	NA	0.4	5.4 / 160	0.005 / 0.05 (20)
Vanadium	X	X	55	0.95	550	NA	NA	470 / 1.4E+4	0.05 / 0.50 (20)
Zinc	X	X	2300	41	2.3E+4	NA	4.2E+4	2E+4 / 6.1E+5	5 / 50 (20)
TPH	X	ND	500 (18)	NA	NA	NA	NA	500 / 2500	500 / 2500

- 1 X - Indicates that chemical was detected in this medium.
- 2 Based on current USEPA Region III guidance (USEPA Region III, October 1995e). Residential soil ingestion for soil and sediment. Fish ingestion for finfish and shellfish.
- 3 USEPA Soil Screening Levels (USEPA, December 1994n). For migration to groundwater, values associated with a dilution and attenuation factor (DAF) presented.
- 4 CTDEP, January 1996.
- 5 1,2-Dichloroethene (mixture).
- 6 Cis-1,2-dichloroethene.
- 7 Trans-1,2-dichloroethene.
- 8 1,3-Dichloropropene (total).
- 9 Xylenes (mixture).
- 10 Chlordane.
- 11 Endosulfan.
- 12 Based on toxicity equivalent factors (TEFs) for 2,3,7,8-TCDD (USEPA, March 1989).
- 13 Chromium (hexavalent).
- 14 Chromium (trivalent).
- 15 Hydrogen cyanide.
- 16 OSWER soil screening level for residential land use (USEPA, July 14, 1994).
- 17 Thallic oxide.
- 18 CTDEP remediation standard for residential land use and GA/GAA pollutant mobility used to qualitatively identify TPH as a COC.
- 19 Total PCBs (sum of all Aroclors).
- 20 Criteria in mg/L for Toxicity Characteristic Leaching procedure (TCLP) or Synthetic Precipitation Leaching Procedure (SPLP) analytical results.
- 21 Total chromium.
- 22 Criteria for SPLP only.
- ND - Not Detected
- NA - Not Available

TABLE 3-6
RISK-BASED COC SCREENING LEVELS AND OTHER-BASED STANDARDS - AIR
NSB-NLON, GROTON, CONNECTICUT
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Chemical	COC Screening Level (1)	ACGIH TLVs (2)		State Remediation Standards (3)	
		TWA (mg/m3)	STEL (mg/m3)	Residential Target Indoor Air Concentration (mg/m3)	Industrial Target Indoor Air Concentration (mg/m3)
Acetone	0.037	1780	2380	0.834	1.17
2-Butanone	0.1	590	885	1.04	1.46
1,1-Dichloroethene	3.6E-5	20	79	4.87E-5	8.18E-5
Methylene chloride	0.0038	174	NA	0.6	0.6
Styrene	0.1	213	426	0.005	0.00717
Toluene	0.042	188	NA	0.417	0.584
1,1,1-Trichloroethane	0.1	1910	2460	1.04	1.46
Trichloroethene	0.001	269	537	0.005	0.005

- 1 Based on current USEPA Region III guidance (USEPA Region III, October 1995e).
- 2 American Conference of Governmental Industrial Hygienists (ACGIH, 1995). Time-Weighted Average (TWA) and Short-Term Exposure Limit (STEL) presented.
- 3 CTDEP, January 1996

NA - Not Available.

TABLE 3-7

**CANCER SLOPE FACTORS FOR CHEMICALS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT**

Chemical	Weight of Evidence	CSF Oral (mg/kg/day) ⁻¹	CSF Inhalation (mg/kg/day) ⁻¹	Gastrointestinal Absorption Factor	CSF Dermal (mg/kg/day) ⁻¹
Aldrin	B2 ⁽²⁾	1.5E+1 ⁽²⁾	1.51E+1 ⁽²⁾	NA ⁽¹⁾	1.5E+1
Aroclors (all)	B2 ⁽²⁾	Water: 3E-1, CTE ⁽²⁵⁾ Water: 4E-1, RME Solid: 1E+0, CTE Solid: 2E+0, RME	-	NA	Water: 3E-1, CTE ⁽²⁵⁾ Water: 4E-1, RME Solid: 1E+0, CTE Solid: 2E+0, RME
Arsenic	A	1.5E+0 ⁽⁴⁾	1.51E+1 ⁽⁴⁾	0.95 ⁽⁸⁾	1.6E+0
Benzene	A ⁽²⁾	2.9E-2 ⁽²⁾	2.9E-2 ⁽²⁾	1.0 ⁽⁹⁾	2.9E-2
Benzo(a)anthracene	B2 ⁽²⁾	7.3E-1 ⁽⁶⁾	-	NA	NA
Benzo(b)fluoranthene	B2 ⁽²⁾	7.3E-1 ⁽⁶⁾	-	NA	NA
Benzo(k)fluoranthene	B2 ⁽²⁾	7.3E-2 ⁽⁶⁾	-	NA	NA
Benzo(a)pyrene	B2 ⁽²⁾	7.3E+0 ⁽²⁾	6.1E+0 ⁽²¹⁾	NA	NA
Beryllium	B2 ⁽²⁾	4.3E+0 ⁽²⁾	8.4E+0 ⁽²⁾⁽²⁴⁾	0.05 ⁽¹⁰⁾	8.6E+1
Bis(2-ethylhexyl)phthalate	B2 ⁽²⁾	1.4E-2 ⁽²⁾	-	0.55 ⁽¹¹⁾	2.5E-2
Bromodichloromethane	B2 ⁽²⁾	6.2E-2 ⁽²⁾	-	NA	6.2E-2
Cadmium	B1 ⁽²⁾	-	6.3E+0 ⁽²⁾	0.05 ⁽¹²⁾	-
Carbazole	-	2.0E-2 ⁽³⁾	-	NA	2.0E-2
Carbon disulfide	-	-	-	NA	-
Chlorobenzene	D	-	-	0.3 ⁽¹³⁾	-
Chlordane	B2 ⁽²⁾	1.3E+0 ⁽²⁾⁽²²⁾	1.29E+0 ⁽²⁾⁽²²⁾	0.80 ⁽¹⁴⁾⁽²²⁾	1.6E+0 ⁽²²⁾
Chloroform	B2 ⁽²⁾	6.1E-3 ⁽²⁾	8.05E-2 ⁽²⁾	1.0 ⁽¹⁵⁾	6.1E-3
Chloromethane	C ⁽³⁾	1.3E-2 ⁽³⁾	6.3E-3 ⁽³⁾	NA	1.3E-2
Chromium	A ⁽²⁾⁽²³⁾	-	4.2E+1 ⁽²⁾⁽²³⁾	NA	-
Chrysene	B2 ⁽²⁾	7.3E-3 ⁽⁶⁾	-	NA	NA
4,4'-DDD	B2 ⁽²⁾	2.4E-1 ⁽²⁾	-	0.8 ⁽¹⁶⁾	3.0E-1
4,4'-DDE	B2 ⁽²⁾	3.4E-1 ⁽²⁾	-	0.8 ⁽¹⁶⁾	4.2E-1
4,4'-DDT	B2 ⁽²⁾	3.4E-1 ⁽²⁾	3.4E-1 ⁽²⁾	0.8 ⁽¹⁶⁾	4.2E-1
Dibenz(a,h)anthracene	B2 ⁽²⁾	7.3E+0 ⁽⁶⁾	-	NA	NA
1,4-Dichlorobenzene	-	2.4E-2 ⁽³⁾	-	1.0 ⁽¹⁷⁾	2.4E-2
3,3'-Dichlorobenzidine	B2 ⁽²⁾	4.5E-1 ⁽²⁾	-	NA	4.5E-1

TABLE 3-7 (Continued)
 CANCER SLOPE FACTORS FOR CHEMICALS OF CONCERN
 NSB-NLON, GROTON, CONNECTICUT

Chemical	Weight of Evidence	CSF Oral (mg/kg/day) ⁻¹	CSF Inhalation (mg/kg/day) ⁻¹	Gastrointestinal Absorption Factor	CSF Dermal (mg/kg/day) ⁻¹
1,2-Dichloroethane	B2 ⁽²⁾	9.1E-2 ⁽²⁾	9.1E-2 ⁽²⁾	NA	9.1E-2
1,1-Dichloroethene	C ⁽²⁾	6E-1 ⁽²⁾	1.75E-1 ⁽²⁾	NA	6E-1
Dieldrin	B2 ⁽²⁾	1.6E+1 ⁽²⁾	1.61E+1 ⁽²⁾	NA	1.6E+1
Heptachlor	B2 ⁽²⁾	4.5E+0 ⁽²⁾	4.55E+0 ⁽²⁾	NA	4.5E+0
Heptachlor epoxide	B2 ⁽²⁾	9.1E+0 ⁽²⁾	9.1E+0 ⁽²⁾	NA	9.1E+0
1,2,3,4,6,7,8-HpCDD	-	1.56E+3 ⁽⁷⁾	-	0.90 ⁽¹⁹⁾	1.73E+3
1,2,3,4,7,8-HxCDF	-	1.56E+4 ⁽⁷⁾	-	0.90 ⁽¹⁹⁾	1.73E+4
1,2,3,6,7,8-HxCDF	-	1.56E+4 ⁽⁷⁾	-	0.90 ⁽¹⁹⁾	1.73E+4
Indeno(1,2,3-cd)pyrene	B2 ⁽²⁾	7.3E-1 ⁽⁶⁾	-	NA	NA
Lead	B2 ⁽²⁾	-	-	0.5 ⁽¹⁸⁾	-
Methylene chloride	B2 ⁽²⁾	7.5E-3 ⁽²⁾	1.64E-3 ⁽²⁾	NA	7.5E-3
2-Methylphenol	C ⁽²⁾	-	-	NA	-
OCDD	-	1.56E+2 ⁽⁷⁾	-	0.90 ⁽¹⁹⁾	1.73E+2
1,1,2,2-Tetrachloroethane	C ⁽²⁾	2.0E-1 ⁽²⁾	2.03E-1 ⁽²⁾	NA	2.0E-1
Tetrachloroethene	-	5.2E-2 ⁽⁵⁾	2.03E-3 ⁽⁵⁾	NA	5.2E-2
Trichloroethene	-	1.1E-2 ⁽²¹⁾	6.0E-3 ⁽⁵⁾	1.0 ⁽²⁰⁾	1.1E-2
Vinyl chloride	-	1.9E+0 ⁽³⁾	3.0E-1 ⁽³⁾	NA	1.9E+0

1 NA - Not Available.

2 IRIS, USEPA, December 1995f.

3 USEPA, March 1994j.

4 Proposed based on carcinogenicity.

5 ECAO provisional value, USEPA, Region III, October 1995e.

6 USEPA, July 1993g; Region I, August 1994m.

7 USEPA, March 1989c; December 1995f.

8 ATSDR, October 1991a.

9 ATSDR, October 1991b.

10 ATSDR, October 1991f.

11 ATSDR, October 1991c.

12 ATSDR, October 1991g.

13 ATSDR, October 1989b.

14 ATSDR, October 1992d.

15 ATSDR, October 1991d.

16 ATSDR, October 1992c.

17 ATSDR, October 1991e.

18 ATSDR, February 1988 value for children.

19 ATSDR, November 1987b.

20 ATSDR, January 1988.

21 Withdrawn from IRIS; no other toxicity criteria available.

22 Used to assess risks associated with alpha- and gamma-chlordane.

23 Hexavalent chromium.

24 Used if air concentration is less than 4 µg/m³.

25 CSFs based on tiered approach to evaluating cancer risks for PCBs (USEPA, September 1996).

TABLE 3-8

ESTIMATED ORDERS OF POTENTIAL POTENCY FOR CARCINOGENIC PAHs⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Chemical	Weight-of-Evidence	Order of Potential Potency
Benzo(a)anthracene	B2	0.1
Benzo(b)fluoranthene	B2	0.1
Benzo(k)fluoranthene	B2	0.01
Benzo(a)pyrene	B2	1.0
Chrysene	B2	0.001
Dibenz(a,h)anthracene	B2	1.0
Indeno(1,2,3-cd)pyrene	B2	0.1

1 USEPA, July 1993g; USEPA Region I, August 1994m.

TABLE 3-9
TOXICITY EQUIVALENCE FACTORS (TEFs) FOR CDDs AND CDFs⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Compound	TEF
2,3,7,8-TCDD	1
Total/2,3,7,8-HxCDD	0.1
Total/2,3,7,8-HpCDD	0.01
OCDD	0.001
Total/2,3,7,8-HxCDF	0.1
Total/2,3,7,8-HpCDF	0.01
OCDF	0.001

1 USEPA, March 1989c.

TABLE 3-10

REFERENCE DOSES AND ENDPOINTS/TARGET ORGANS FOR CHEMICALS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Chemical	RfD Oral- Chronic (mg/kg/day)	RfD Inhalation- Chronic (mg/kg/day)	Gastrointestinal Absorption Factor	RfD Dermal- Chronic (mg/kg/day)	Toxic Endpoints or Target Organs
Acetone	1E-1 ⁽²⁾	-	0.80 ⁽²⁵⁾	8E-1	Liver, kidney
Aldrin	3E-5 ⁽²⁾	-	NA ⁽¹⁾	3E-5	Liver
Antimony	4E-4 ⁽²⁾	-	0.95	4E-4	Whole body, blood
Aroclors (all)	2E-5 ⁽²⁾⁽²⁸⁾	-	NA	2E-5	Eyes, fingers, nails
Arsenic	3E-4 ⁽²⁾	-	0.95 ⁽⁷⁾	2.8E-4	Skin
Barium	7E-2 ⁽²⁾	1.43E-4 ⁽⁶⁾	0.05 ⁽⁴⁾	3.5E-3	Cardiovascular (oral) Fetus (inhalation)
Benzene	-	1.71E-3 ⁽⁵⁾	1.0 ⁽¹⁶⁾	-	Not Reported
Beryllium	5E-3 ⁽²⁾	-	0.05 ⁽¹⁷⁾	2.5E-4	Not Reported
Bis(2-ethylhexyl)phthalate	2E-2 ⁽²⁾	-	0.55 ⁽¹⁴⁾	1.1E-2	Liver
Boron	9E-2 ⁽²⁾	5.71E-3 ⁽⁶⁾	0.05 ⁽⁴⁾	4.5E-3	Testes (oral) Respiratory (inhalation)
Bromodichloromethane	2E-2 ⁽²⁾	-	NA	2E-2	Kidney
Cadmium	5E-4 ⁽²⁾	5.71E-5 ⁽⁵⁾	0.05 ⁽⁸⁾	2.5E-5	Kidney
Carbon disulfide	1E-1 ⁽²⁾	2.0E-1 ⁽²⁾	NA	1E-1	Fetus (oral & inhalation)
Chlordane	6E-5 ⁽²⁾	-	0.80 ⁽²⁸⁾	4.8E-5	Liver
Chlorobenzene	2E-2 ⁽²⁾	5.71E-3 ⁽⁶⁾	0.3 ⁽¹⁸⁾	6E-3	Liver (oral) Liver, kidney (inhalation)
Chloroform	1E-2 ⁽²⁾	-	1.0 ⁽¹⁸⁾	1E-2	Liver
Chromium	5E-3 ⁽²⁾⁽³¹⁾	-	0.02 ⁽³³⁾	1E-4	Not Reported
Dibenzofuran	4E-3 ⁽⁵⁾	-	NA	4E-3	Not Reported
Di-n-butylphthalate	1E-1 ⁽²⁾	-	0.90 ⁽²⁶⁾	9E-2	Whole body
2,4-Dinitrotoluene	2E-3 ⁽²⁾	-	NA	2E-3	Not Reported
4,4'-DDT	5E-4 ⁽²⁾	-	0.80 ⁽²⁰⁾	4E-4	Liver
1,4-Dichlorobenzene	-	2.29E-1 ⁽²⁾	1.0 ⁽²¹⁾	-	Liver
1,2-Dichloroethane	-	2.86E-3 ⁽⁵⁾	NA	-	Not Reported
1,1-Dichloroethene	9E-3 ⁽²⁾	-	NA	9E-3	Liver
1,2-Dichloroethene (mixture)	9E-3 ⁽⁶⁾	-	NA	9E-3	Liver
Dieldrin	5E-5 ⁽²⁾	-	NA	5E-5	Liver
2,4-Dimethylphenol	2E-2 ⁽²⁾	-	NA	2E-2	CNS, blood
Heptachlor	5E-4 ⁽²⁾	-	NA	5E-4	Liver

TABLE 3-10 (Continued)
REFERENCE DOSES AND ENDPOINTS/TARGET ORGANS FOR CHEMICALS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Chemical	RfD Oral- Chronic (mg/kg/day)	RfD Inhalation- Chronic (mg/kg/day)	Gastrointestinal Absorption Factor	RfD Dermal- Chronic (mg/kg/day)	Toxic Endpoints or Target Organs
Heptachlor epoxide	1.3E-5 ⁽²⁾	1	NA	1.3E-5	Liver
Manganese	2.4E-2	1.43E-5 ⁽²⁾	0.03 ⁽¹⁰⁾	7.2E-4	Not Reported
Mercury	3E-4 ⁽⁶⁾	8.57E-5 ⁽⁶⁾	0.05 ⁽¹¹⁾	1.5E-5	Kidney (oral) CNS (inhalation)
Methoxychlor	5E-3 ⁽²⁾	-	NA	5E-3	Reproduction
Methylene chloride	6E-2 ⁽²⁾	8.57E-1 ⁽⁶⁾	1.0 ⁽¹⁵⁾	6E-2	Liver (oral and inhalation)
2-Methylphenol	5E-2 ⁽²⁾	-	NA	5E-2	Respiratory system, whole body effects
4-Methylphenol	5E-3 ⁽⁶⁾	-	NA	5E-3	CNS, respiratory system, whole body
Naphthalene	4E-2 ⁽³⁰⁾	-	NA	4E-2	Whole body
Nickel	2E-2 ⁽²⁾	-	0.10 ⁽¹²⁾	2E-3	Whole body, major organs
2-Nitroaniline	6E-5 ⁽³⁰⁾	5.71E-5 ⁽⁶⁾	NA	6E-5	Blood (oral & inhalation)
Selenium	5E-3 ⁽²⁾	-	0.20 ⁽²⁴⁾	1E-3	Whole body
Silver	5E-3 ⁽²⁾	-	0.05 ⁽⁴⁾	2.4E-4	Skin
Tetrachloroethene	1E-2 ⁽²⁾	-	NA	1E-2	Liver
Thallium	8E-5 ⁽³⁾	-	0.05 ⁽⁴⁾	4E-6	Liver, blood, hair
Toluene	2E-1 ⁽²⁾	1.14E-1 ⁽²⁾	NA	2E-1	Liver, kidney
1,1,1-Trichloroethane	9E-2 ⁽³⁰⁾	2.86E-1 ⁽³⁰⁾	0.80 ⁽²⁷⁾	7.2E-2	Liver (oral) CNS, heart (inhalation)
1,1,2-Trichloroethane	4E-3 ⁽²⁾	-	NA	4E-3	Not Reported
1,2,4-Trichlorobenzene	1E-2 ⁽²⁾	5.71E-2 ⁽⁶⁾	NA	1E-2	Adrenal glands (oral) Liver (inhalation)
Trichloroethene	6E-3 ⁽⁵⁾	-	1.0 ⁽²²⁾	6E-3	Not Reported
Vanadium	7E-3 ⁽⁶⁾	-	0.05 ⁽⁴⁾	3.5E-4	Not Reported

TABLE 3-10 (Continued)
REFERENCE DOSES AND ENDPOINTS/TARGET ORGANS FOR CHEMICALS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Chemical	RfD Oral- Chronic (mg/kg/day)	RfD Inhalation- Chronic (mg/kg/day)	Gastrointestinal Absorption Factor	RfD Dermal- Chronic (mg/kg/day)	Toxic Endpoints or Target Organs
Xylenes	2E+0 ⁽²⁾	-	0.90 ⁽²³⁾	1.8E+0	CNS, whole blood
Zinc	3E-1 ⁽²⁾	-	0.50 ⁽¹³⁾	1.5E-1	Blood

- | | | | |
|----|---|----|--|
| 1 | NA - Not Available. | 18 | ATSDR, October 1989b. |
| 2 | USEPA, December 1995f. | 19 | ATSDR, October 1991d. |
| 3 | Value for thallic carbonate. | 20 | ATSDR, October 1992c. |
| 4 | Default value, USEPA, December 1989f. | 21 | ATSDR, October 1991e. |
| 5 | ECAO provisional value; USEPA Region III,
October 1995e. | 22 | ATSDR, January 1988. |
| 6 | USEPA, March 1994j. | 23 | ATSDR, October 1989a. |
| 7 | ATSDR, October 1991a. | 24 | USEPA, September 1984b. |
| 8 | ATSDR, October 1991g. | 25 | ATSDR, October 1992f. |
| 9 | ATSDR, October 1989d. | 26 | ATSDR, October 1989e. |
| 10 | USEPA, September 1984a. | 27 | ATSDR, October 1989f. |
| 11 | ATSDR, October 1992e. | 28 | Value for Aroclor-1254 used to assess risks for all
aroclor. |
| 12 | ATSDR, October 1991h. | 29 | ATSDR, October 1992d. |
| 13 | Elinder, 1986. | 30 | Withdrawn from IRIS; no other toxicity criteria
available. |
| 14 | ATSDR, October 1991c. | 31 | Hexavalent chromium. |
| 15 | ATSDR, October 1993a. | 32 | Derived by assuming ingestion of 2L/day over a
lifetime. Chronic exposure benchmark, 1,3 mg/L,
used (USEPA, March 1994). |
| 16 | ATSDR, October 1991b. | 33 | ATSDR, October 1991j. |
| 17 | ATSDR, October 1991f. | | |

TABLE 3-11

HEALTH ADVISORIES FOR CHEMICALS OF CONCERN⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Chemical	Health Advisory (mg/L)
Acetone	NA
Aldrin	1-Day/Child: 0.0003 10-Day/Child: 0.0003 Longer-term/Child: 0.0003 Longer-term/Adult: 0.0003
Aluminum	NA
Antimony	1-Day/Child: 0.01 10-Day/Child: 0.01 Longer-term/Child: 0.01 Longer-term/Adult: 0.015 Lifetime: 0.003
Aroclor	NA
Arsenic	NA
Barium	Lifetime: 2
Benzo(a)anthracene	NA
Benzene	1-Day/Child: 0.2 10-Day/Child: 0.2
Benzo(b)fluoranthene	NA
Benzo(k)fluoranthene	NA
Benzo(a)pyrene	NA
Beryllium	1-Day/Child: 30 10-Day/Child: 30 Longer-term/Child: 4 Longer-term/Adult: 20
Bis(2-ethylhexyl)phthalate	NA
Boron	1-Day/Child: 4 10-Day/Child: 0.9 Longer-term/Child: 0.9 Longer-term/Adult: 3 Lifetime: 0.6
Bromodichloromethane	1-Day/Child: 7 10-Day/Child: 7 Longer-term/Child: 4 Longer-term/Adult: 13
Cadmium	1-Day/Child: 0.04 10-Day/Child: 0.04 Longer-term/Child: 0.005 Longer-term/Adult: 0.02 Lifetime: 0.005
Carbazole	NA

TABLE 3-11 (Continued)
HEALTH ADVISORIES FOR CHEMICALS OF CONCERN⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Chemical	Health Advisory (mg/L)
Carbon disulfide	NA
γ -Chlordane	1-Day/Child: 0.06 10-Day/Child: 0.06
Chlorobenzene	1-Day/Child: 2 10-Day/Child: 2 Longer-term/Child: 2 Longer-term/Adult: 7 Lifetime: 0.1
Chloroform	1-Day/Child: 4 10-Day/Child: 4 Longer-term/Child: 0.1 Longer-term/Adult: 0.4
Chloromethane	1-Day/Child: 9 10-Day/Child: 0.4 Longer-term/Child: 0.4 Longer-term/Adult: 1 Lifetime: 0.003
Chromium	1-Day/Child: 1 10-Day/Child: 1 Longer-term/Child: 0.2 Longer-term/Adult: 0.8 Lifetime: 0.1
Chrysene	1-Day/Child: 0.1 10-Day/Child: 0.1 Longer-term/Child: 0.02 Longer-term/Adult: 0.07 Lifetime: 0.001
Copper	NA
4,4'-DDD	NA
4,4'-DDE	NA
4,4'-DDT	NA
Dibenz(a,h)anthracene	NA
Dibenzofuran	NA
Di-n-butylphthalate	NA
1,4-Dichlorobenzene	1-Day/Child: 10 10-Day/Child: 10 Longer-term/Child: 10 Longer-term/Adult: 40 Lifetime: 0.075
3,3'-Dichlorobenzidine	NA

TABLE 3-11 (Continued)
HEALTH ADVISORIES FOR CHEMICALS OF CONCERN⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Chemical	Health Advisory (mg/L)
1,2-Dichloroethane	1-Day/Child: 0.7 10-Day/Child: 0.7 Longer-term/Child: 0.7 Longer-term/Adult: 2.6
cis-1,2-Dichloroethene	1-Day/Child: 4 10-Day/Child: 3 Longer-term/Child: 3 Longer-term/Adult: 11 Lifetime: 0.07
trans-1,2-Dichloroethene	1-Day/Child: 20 10-Day/Child: 2 Longer-term/Child: 2 Longer-term/Adult: 6 Lifetime: 0.1
1,1-Dichloroethene	1-Day/Child: 2 10-Day/Child: 1 Longer-term/Child: 1 Longer-term/Adult: 4 Lifetime: 0.007
Dieldrin	1-Day/Child: 0.0005 10-Day/Child: 0.0005 Longer-term/Child: 0.0005 Longer-term/Adult: 0.002
2,4-Dimethylphenol	NA
2,4-Dinitrotoluene	1-Day/Child: 0.50 10-Day/Child: 0.50 Longer-term/Child: 0.30 Longer-term/Adult: 1
Heptachlor	1-Day/Child: 0.01 10-Day/Child: 0.01 Longer-term/Child: 0.005 Longer-term/Adult: 0.005
Heptachlor epoxide	1-Day/Child: 0.01 Longer-term/Child: 0.0001 Longer-term/Adult: 0.0001
1,2,3,4,6,7,8-HpCDD	NA
1,2,3,4,7,8-HxCDF	NA
1,2,3,6,7,8-HxCDF	NA
Indeno(1,2,3-cd)pyrene	NA
Iron	NA
Lead	NA
Manganese	NA
Mercury	Lifetime: 0.002

TABLE 3-11 (Continued)
HEALTH ADVISORIES FOR CHEMICALS OF CONCERN⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Chemical	Health Advisory (mg/L)
Methoxychlor	1-Day/Child: 0.05 10-Day/Child: 0.05 Longer-term/Child: 0.05 Longer-term/Adult: 0.2 Lifetime: 0.04
Methylene chloride	1-Day/Child: 10 10-Day/Child: 2
2-Methylphenol	NA
4-Methylphenol	NA
Naphthalene	1-Day/Child: 0.5 10-Day/Child: 0.5 Longer-term/Child: 0.4 Longer-term/Adult: 1 Lifetime: 0.02
Nickel	1-Day/Child: 1 10-Day/Child: 1 Longer-term/Child: 0.5 Longer-term/Adult: 1.7 Lifetime: 0.1
2-Nitroaniline	NA
OCDD	NA
Selenium	NA
Silver	1-Day/Child: 0.2 10-Day/Child: 0.2 Longer-term/Child: 0.2 Longer-term/Adult: 0.2 Lifetime: 0.1
1,1,2,2-Tetrachloroethane	NA
Tetrachloroethene	1-Day/Child: 2 10-Day/Child: 2 Longer-term/Child: 1 Longer-term/Adult: 5
Thallium	1-Day/Child: 0.007 10-Day/Child: 0.007 Longer-term/Child: 0.007 Longer-term/Adult: 0.02 Lifetime: 0.0004
Toluene	1-Day/Child: 20 10-Day/Child: 2 Longer-term/Child: 2 Longer-term/Adult: 7 Lifetime/Adult: 1

TABLE 3-11 (Continued)
HEALTH ADVISORIES FOR CHEMICALS OF CONCERN⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Chemical	Health Advisory (mg/L)
1,2,4-Trichlorobenzene	1-Day/Child: 0.1 10-Day/Child: 0.1 Longer-term/Child: 0.1 Longer-term/Adult: 0.5 Lifetime: 0.07
1,1,1-Trichloroethane	1-Day/Child: 100 10-Day/Child: 40 Longer-term/Child: 40 Longer-term/Adult: 100 Lifetime: 0.2
1,1,2-Trichloroethane	1-Day/Child: 0.6 10-Day/Child: 0.4 Longer-term/Child: 0.4 Longer-term/Adult: 1 Lifetime: 0.003
Trichloroethene	NA
Vanadium	NA
Vinyl chloride	1-Day/Child: 3 10-Day/Child: 3 Longer-term/Child: 0.01 Longer-term/Adult: 0.05
Xylenes	1-Day/Child: 40 10-Day/Child: 40 Longer-term/Child: 40 Longer-term/Adult: 100 Lifetime: 10
Zinc	1-Day/Child: 6 10-Day/Child: 6 Longer-term/Child: 3 Longer-term/Adult: 12 Lifetime: 2

1 USEPA, May 1995c.

NA Not Available

TABLE 3-12
SUMMARY OF RECEPTORS BY SITE
NSB-NLON, GROTON, CONNECTICUT

Site	Full-Time Employees	Construction Workers	Older Child Trespassers (6-16 years)	Recreational Users		Future Residents (Adult/Child)
				Adult	Child	
1 - CBU Drum Storage Area	--	X	X	--	--	--
2 - Area A Landfill	X	X	X	--	--	--
2 - Area A Wetlands	--	X	X	--	--	--
3 - Area A Weapons Center	X	X	--	--	--	X
3 - Area A Downstream/OBDA	--	X	X	X ⁽¹⁾	X ⁽¹⁾	--
4 - Rubble Fill at Bunker A86	--	X	X	--	--	--
6 - DRMO	X	X	X	--	--	X
7 - Torpedo Shops	X	X	--	--	--	X
8 - Goss Cove Landfill	X	X	X	--	--	X
Lower Subase	X	X	--	--	--	X
14 - OBDANE	--	X	X	--	--	--
15 - Spent Acid Storage/Disposal Area	--	X	--	--	--	X
Thames River	--	--	--	X	--	--

1 Evaluation performed for North Lake only.

TABLE 3-13
SUMMARY OF EXPOSURE ROUTES EVALUATED QUANTITATIVELY
NSB-NLON, GROTON, CONNECTICUT

Receptors	Exposure Routes
Potentially Complete Exposure Pathways	
Construction Workers	<ul style="list-style-type: none"> • Soil Ingestion (subsurface and surface) • Soil Dermal Contact (subsurface and surface)⁽¹⁾ • Inhalation of Air/Dust (subsurface and surface) • Dermal Contact with Groundwater
Full-Time Employees	<ul style="list-style-type: none"> • Soil Ingestion (surface) • Soil Dermal Contact (surface)⁽¹⁾ • Inhalation of Air/Dust (surface)
Older Child Trespassers (ages 6-16 years)	<ul style="list-style-type: none"> • Soil Ingestion (surface) • Soil Dermal Contact (surface)⁽¹⁾ • Inhalation of Air/Dust (surface) • Surface Water Ingestion • Surface Water Dermal Contact • Sediment Ingestion • Sediment Dermal Contact⁽¹⁾
Adult and Child Recreational Users ⁽²⁾	<ul style="list-style-type: none"> • Surface Water Ingestion (swimming/skiing) • Surface Water Dermal Contact (swimming/skiing) • Sediment Ingestion (swimming) • Sediment Dermal Contact (swimming)⁽¹⁾ • Ingestion of Finfish/Shellfish
Incomplete Exposure Pathways	
Future Residents (Adult/Child)	<ul style="list-style-type: none"> • Soil Ingestion (surface and subsurface) • Soil Dermal Contact (surface and subsurface)⁽¹⁾ • Inhalation of Air/Dust (surface and subsurface) • Direct Ingestion of Groundwater⁽³⁾ • Dermal Contact with Groundwater while Showering/Bathing⁽³⁾

1 Quantitative evaluation performed for cadmium, PCBs, and dioxins.

2 Swimming evaluated for North Lake (adult and child); waterskiing and ingestion of finfish/shellfish evaluated for Thames River (adult only).

3 Exposure to groundwater not evaluated for sites along Thames River (DRMO, Goss Cove Landfill, and Lower Subase) because of saline conditions.

TABLE 3-14

EXPOSURE PARAMETERS FOR TRESPASSERS AND FUTURE RESIDENTS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Exposure Scenario	Parameter (units)	Older Child Trespasser (6-16 years)		Future Residents ⁽²⁾			
				Adult		Child	
		RME	CTE	RME	CTE	RME	CTE
Soil/Sediment Ingestion	Exposure Concentration (mg/kg)	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL
	Ingestion Rate (mg/day)	100	50	100	50	200	100
	Exposure Frequency (day/yr)	120 ⁽³⁾	52 ⁽³⁾	150	150	150	150
	Exposure Duration (yr)	10 ⁽⁴⁾	3 ⁽⁴⁾	24	7	6	2
	Body Weight (kg)	43 ⁽⁵⁾	43 ⁽⁵⁾	70	70	15	15
Soil/Sediment Dermal Contact	Exposure Concentration (mg/kg)	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL
	Body Surface Area (cm ²)	10500 ⁽⁶⁾	10500 ⁽⁶⁾	20000 ⁽⁶⁾	20000 ⁽⁶⁾	6980 ⁽⁶⁾	6980 ⁽⁶⁾
	Fraction Exposed (forearms, head, hands)	0.30 ⁽⁵⁾	0.30 ⁽⁵⁾	0.19 ⁽⁵⁾	0.19 ⁽⁵⁾	0.30 ⁽⁵⁾	0.30 ⁽⁵⁾
	Adherence Factor (mg/cm ²)	1.0 ⁽⁶⁾	0.2 ⁽⁶⁾	1.0 ⁽⁶⁾	0.2 ⁽⁶⁾	1.0 ⁽⁶⁾	0.2 ⁽⁶⁾
	Exposure Frequency (day/yr)	120 ⁽³⁾	52 ⁽³⁾	150	150	150	150
	Exposure Duration (yr)	10 ⁽⁴⁾	3 ⁽⁴⁾	24	7	6	2
	Body Weight (kg)	43 ⁽⁵⁾	43 ⁽⁵⁾	70	70	15	15
Inhalation of Air/Dust	PM10 Exposure Concentration (mg/m ³)	1.8E-8 X UCL ⁽³⁾	1.8E-8 X UCL ⁽³⁾	1.8E-8 X UCL ⁽³⁾	1.8E-8 X UCL ⁽³⁾	NA ⁽⁸⁾	NA
	Inhalation Rate (m ³ /hr)	3.2 ⁽⁵⁾	3.2 ⁽⁵⁾	0.833 ⁽⁷⁾	0.833 ⁽⁷⁾	NA	NA
	Exposure Time (hr/day)	4 ⁽⁴⁾	2 ⁽⁴⁾	24	24	NA	NA
	Exposure Frequency (day/yr)	120 ⁽³⁾	52 ⁽³⁾	350	234	NA	NA
	Exposure Duration (yr)	10 ⁽⁴⁾	3 ⁽⁴⁾	30	9	NA	NA
	Body Weight (kg)	43 ⁽⁵⁾	43 ⁽⁵⁾	70	70	NA	NA

TABLE 3-14 (Continued)
EXPOSURE PARAMETERS FOR TRESPASSERS AND FUTURE RESIDENTS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Exposure Scenario	Parameter (units)	Older Child Trespasser (6-16 years)		Future Residents ⁽²⁾			
				Adult		Child	
		RME	CTE	RME	CTE	RME	CTE
Groundwater Ingestion	Exposure Concentration (mg/L)	NA	NA	Maximum	Average	NA	NA
	Ingestion Rate (L/day)	NA	NA	2	1.4	NA	NA
	Exposure Frequency (day/yr)	NA	NA	350	234	NA	NA
	Exposure Duration (yr)	NA	NA	30	9	NA	NA
	Body Weight (kg)	NA	NA	70	70	NA	NA
Groundwater Dermal Contact (Showering/Bathing)	Exposure Concentration (mg/L)	NA	NA	Maximum	Average	NA	NA
	Body Surface Area (cm ²)	NA	NA	20000 ⁽⁶⁾	20000 ⁽⁶⁾	NA	NA
	Fraction Exposed (whole body)	NA	NA	1.0 ⁽⁴⁾	1.0 ⁽⁴⁾	NA	NA
	Event Frequency (events/day)	NA	NA	1	1	NA	NA
	Duration of Event (hr/event)	NA	NA	0.25 ⁽⁴⁾⁽⁹⁾	0.167 ⁽⁴⁾⁽⁹⁾	NA	NA
	Exposure Frequency (day/yr)	NA	NA	350	234	NA	NA
	Exposure Duration (yr)	NA	NA	30	9	NA	NA
	Body Weight (kg)	NA	NA	70	70	NA	NA

TABLE 3-14 (Continued)
EXPOSURE PARAMETERS FOR TRESPASSERS AND FUTURE RESIDENTS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Exposure Scenario	Parameter (units)	Older Child Trespasser (6-16 years)		Future Residents ⁽²⁾			
		RME	CTE	Adult		Child	
				RME	CTE	RME	CTE
Surface Water Ingestion	Exposure Concentration (mg/L)	95% UCL	95% UCL	NA	NA	NA	NA
	Ingestion Rate (L/hr)	0.05 ⁽¹⁰⁾	0.05 ⁽¹⁰⁾	NA	NA	NA	NA
	Exposure Time (hr/day)	4 ⁽⁴⁾	2 ⁽⁴⁾	NA	NA	NA	NA
	Exposure Frequency (day/yr)	120 ⁽³⁾	52 ⁽³⁾	NA	NA	NA	NA
	Exposure Duration (yr)	10 ⁽⁴⁾	3 ⁽⁴⁾	NA	NA	NA	NA
	Body Weight (kg)	43 ⁽⁵⁾	43 ⁽⁵⁾	NA	NA	NA	NA
Surface Water Dermal Contact	Exposure Concentration (mg/L)	95% UCL	95% UCL	NA	NA	NA	NA
	Body Surface Area (cm ²)	10500 ⁽⁶⁾	10500 ⁽⁶⁾	NA	NA	NA	NA
	Fraction Exposed (forearms, head, hands)	0.30 ⁽⁵⁾	0.30 ⁽⁵⁾	NA	NA	NA	NA
	Event Frequency (events/day)	1	1	NA	NA	NA	NA
	Duration of event (hr/event)	4 ⁽⁴⁾	2 ⁽⁴⁾	NA	NA	NA	NA
	Exposure Frequency (day/yr)	120 ⁽³⁾	52 ⁽³⁾	NA	NA	NA	NA
	Exposure Duration (yr)	10 ⁽⁴⁾	3 ⁽⁴⁾	NA	NA	NA	NA
	Body Weight (kg)	43 ⁽⁵⁾	43 ⁽⁵⁾	NA	NA	NA	NA

- 1 USEPA Region I, August 1994m, unless otherwise noted.
 2 A 30- and 9-year future resident evaluated (RME AND CTE). Age-adjusted ingestion and dermal contact rates will be used for soil/sediment exposures.
 3 Based on Phase I RI (Atlantic, August 1992).
 4 Professional judgement.

- 5 USEPA, May 1989d.
 6 USEPA, January 1992d.
 7 20 m³/day.
 8 NA - Exposure route not evaluated.
 9 For RME, 15 minutes/event and 10 minutes/event for CTE.
 10 USEPA, April 1988b.

TABLE 3-15

EXPOSURE PARAMETERS FOR FULL-TIME EMPLOYEES AND CONSTRUCTION WORKERS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Exposure Scenario	Parameter (units)	Full-Time Employee		Construction Worker	
		RME	CTE	RME	CTE
Soil Ingestion	Exposure Concentration (mg/kg)	95% UCL	95% UCL	95% UCL	95% UCL
	Ingestion Rate (mg/day)	100	50	480	240 ⁽²⁾
	Exposure Frequency (day/yr)	150	150	120 ⁽³⁾	80 ⁽³⁾
	Exposure Duration (yr)	25	6 ⁽³⁾	1 ⁽³⁾	1 ⁽³⁾
	Body Weight (kg)	70	70	70	70
Soil Dermal Contact	Exposure Concentration (mg/kg)	95% UCL	95% UCL	95% UCL	95% UCL
	Body Surface Area (cm ²)	20000 ⁽⁴⁾	20000 ⁽⁴⁾	20000 ⁽⁴⁾	20000 ⁽⁴⁾
	Fraction Exposed (forearms, head, hands)	0.19 ⁽⁵⁾	0.19 ⁽⁵⁾	0.19 ⁽⁵⁾	0.19 ⁽⁵⁾
	Adherence Factor (mg/cm ²)	1.0 ⁽⁴⁾	0.2 ⁽⁴⁾	1.0 ⁽⁴⁾	0.2 ⁽⁴⁾
	Exposure Frequency (day/yr)	150	150	120 ⁽³⁾	80 ⁽³⁾
	Exposure Duration (yr)	25	6 ⁽³⁾	1 ⁽³⁾	1 ⁽³⁾
	Body Weight (kg)	70	70	70	70
Inhalation of Dust/Air	PM10 Exposure Concentration (mg/m ³)	1.8E-8 X UCL ⁽³⁾	1.8E-8 X UCL ⁽³⁾	9E-8 X UCL ⁽³⁾	9E-8 X UCL ⁽³⁾
	Inhalation Rate (m ³ /hr)	2.5 ⁽⁵⁾	2.5 ⁽⁵⁾	3.9 ⁽⁵⁾	3.9 ⁽⁵⁾
	Exposure Time (hr/day)	8 ⁽²⁾	8 ⁽²⁾	8 ⁽²⁾	8 ⁽²⁾
	Exposure Frequency (day/yr)	150	150	120 ⁽³⁾	80 ⁽³⁾
	Exposure Duration (yr)	25	6 ⁽³⁾	1 ⁽³⁾	1 ⁽³⁾
	Body Weight (kg)	70	70	70	70
Groundwater Dermal Contact	Exposure Concentration (mg/L)	NA ⁽⁶⁾	NA	Maximum	Average
	Body Surface Area (cm ²)	NA	NA	20000 ⁽⁴⁾	20000 ⁽⁴⁾
	Fraction Exposed (forearms, head, hands)	NA	NA	0.19 ⁽⁵⁾	0.19 ⁽⁵⁾
	Event Frequency (events/day)	NA	NA	1	1
	Duration of Event (hr/event)	NA	NA	8 ⁽²⁾	8 ⁽²⁾
	Exposure Frequency (days/yr)	NA	NA	120 ⁽³⁾	80 ⁽³⁾
	Exposure Duration (yr)	NA	NA	1 ⁽³⁾	1 ⁽³⁾
	Body Weight (kg)	NA	NA	70	70

1 USEPA Region I, August 1994, unless otherwise noted.

2 Professional judgement.

3 Based on Phase I RI (Atlantic, August 1992).

4 USEPA, January 1992.

5 USEPA, May 1989.

6 NA - Exposure route not evaluated.

TABLE 3-16

EXPOSURE PARAMETERS FOR RECREATIONAL USERS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Exposure Scenario	Parameter (units)	Recreational Users			
		Adult		Child	
		RME	CTE	RME	CTE
Surface Water Dermal Contact	Exposure Concentration (mg/L)	95% UCL	95% UCL	95% UCL	95% UCL
	Body Surface Area (cm ²)	20000 ⁽²⁾	20000 ⁽²⁾	6980 ⁽²⁾	6980 ⁽²⁾
	Fraction Exposed (whole body)	1.0 ⁽³⁾	1.0 ⁽³⁾	1.0 ⁽³⁾	1.0 ⁽³⁾
	Event Frequency (event/day)	1	1	1	1
	Duration of Event (hr/event)	4 ⁽⁴⁾ 2.6 ⁽⁵⁾	2 ⁽⁴⁾ 2.6 ⁽⁵⁾	4 ⁽⁴⁾	2 ⁽⁴⁾
	Exposure Frequency (day/yr)	22 ⁽⁴⁾ 16 ⁽⁵⁾	22 ⁽⁴⁾ 8 ⁽⁵⁾	55 ⁽⁴⁾	55 ⁽⁴⁾
	Exposure Duration (yr)	30	9	6	2
	Body Weight (kg)	70	70	15	15
Surface Water Ingestion	Exposure Concentration (mg/L)	95% UCL	95% UCL	95% UCL	95% UCL
	Contact Rate (L/hr)	0.05 ⁽⁶⁾	0.05 ⁽⁶⁾	0.05 ⁽⁵⁾	0.05 ⁽⁵⁾
	Exposure Time (hr/day)	4 ⁽⁴⁾ 2.6 ⁽⁵⁾	2 ⁽⁴⁾ 2.6 ⁽⁵⁾	4 ⁽⁴⁾	2 ⁽⁴⁾
	Exposure Frequency (day/yr)	22 ⁽⁴⁾ 16 ⁽⁵⁾	22 ⁽⁴⁾ 8 ⁽⁵⁾	55 ⁽⁴⁾	55 ⁽⁴⁾
	Exposure Duration (yr)	30	9	6	2
	Body Weight (kg)	70	70	15	15
Sediment Dermal Contact	Exposure Concentration (mg/kg)	95% UCL	95% UCL	95% UCL	95% UCL
	Body Surface Area (cm ²)	20000 ⁽²⁾	20000 ⁽²⁾	6980 ⁽²⁾	6980 ⁽²⁾
	Fraction Exposed (hands, lower extremities)	0.50 ⁽⁷⁾	0.50 ⁽⁷⁾	0.50 ⁽⁷⁾	0.50 ⁽⁷⁾
	Adherence Factor (mg/cm ³)	1.0 ⁽²⁾	0.2 ⁽²⁾	1.0 ⁽⁴⁾	0.2 ⁽⁴⁾
	Exposure Frequency (day/yr)	22 ⁽⁴⁾	22 ⁽⁴⁾	55 ⁽⁴⁾	55 ⁽⁴⁾
	Exposure Duration (yr)	30	9	6	2
	Body Weight (kg)	70	70	15	15

TABLE 3-16 (Continued)
EXPOSURE PARAMETERS FOR RECREATIONAL USERS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Exposure Scenario	Parameter (units)	Recreational Users			
		Adult		Child	
		RME	CTE	RME	CTE
Sediment Ingestion	Exposure Concentration (mg/kg)	95% UCL	95% UCL	95% UCL	95% UCL
	Ingestion Rate (mg/day)	100	50	200	100
	Exposure Frequency (day/yr)	22 ⁽⁴⁾	22 ⁽⁴⁾	55 ⁽⁴⁾	55 ⁽⁴⁾
	Exposure Duration (yr)	30	9	6	2
	Body Weight (kg)	70	70	15	15
Finfish/Shellfish Ingestion	Exposure Concentration (mg/kg)	95% UCL ⁽⁸⁾ BCF X UCL ⁽⁹⁾	95% UCL ⁽⁸⁾ BCF X UCL ⁽⁹⁾	NA ⁽¹⁰⁾	NA
	Ingestion Rate (kg/day)	0.055 ⁽⁸⁾ 0.054 ⁽⁹⁾	0.003 ⁽⁸⁾ 0.0095 ⁽⁹⁾	NA	NA
	Exposure Frequency (day/yr)	350	234	NA	NA
	Exposure Duration (yr)	30	9	NA	NA
	Body Weight (kg)	70	70	NA	NA

- 1 USEPA Region I, August 1994m, unless otherwise noted.
- 2 USEPA, January 1992d.
- 3 Conservative assumption.
- 4 Professional judgment for swimming.
- 5 Professional judgment for waterskiing.
- 6 USEPA, April 1988b.
- 7 USEPA, May 1989d.
- 8 For shellfish.
- 9 For finfish. (BCF multiplied by surface water 95% UCL to estimate chemical concentration in finfish tissue.)
- 10 NA - Exposure route not evaluated.

TABLE 3-17

**SUMMARY OF BENCHMARK VALUES USED TO IDENTIFY ECOLOGICAL CONTAMINANTS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT**

Chemicals	Onsite Surface Water (ug/L)	Onsite Sediment (mg/kg)	Thames River/ Goss Cove Surface Water (ug/L)	Thames River/ Goss Cove Sediment (mg/kg)	Terrestrial Vegetation (mg/kg)	Soil Invertebrates (mg/kg and mg/L)	Mammal Endpoint	Mammals Test Result (mg/kg/d)	Bird Endpoint	Bird Test Result (mg/kg/d)
1,1,1-Trichloroethane	8.2E + 1 ⁽¹⁾	• ⁽⁵⁾	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	7.8E+0 ⁽¹³⁾	LOAEL	8.9E + 1 ⁽¹⁷⁾	LOAEL	8.9E + 1 ⁽¹⁷⁾
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	7.3E+0 ⁽¹³⁾	NOAEL	1.0E + 3 ⁽¹⁸⁾	NOAEL	1.0E + 3 ⁽¹⁸⁾
1,1-Dichloroethane	NA	NA	NA	NA	NA	8.6E+0 ⁽¹³⁾	NOAEL	3.0E + 1 ⁽¹⁹⁾	NOAEL	3.0E + 1 ⁽¹⁹⁾
1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NOAEL	1.0E-6 ⁽²⁰⁾	NOAEL	1.4E-5 ⁽²⁰⁾
1,2-Dichloroethane (total)	NA	NA	NA	NA	NA	8.6E+0 ⁽¹³⁾	NOAEL	4.5E + 2 ⁽¹⁹⁾	NOAEL	4.5E + 2 ⁽¹⁹⁾
1,4-Dichlorobenzene	1.5E + 1 ⁽²⁾	• ⁽⁵⁾	NA	NA	NA	3.4E+0 ⁽¹³⁾	NOAEL	8.6E + 1 ⁽²¹⁾	NOAEL	8.6E + 1 ⁽²¹⁾
2,4-Dimethylphenol	1.3E + 3 ⁽¹⁾	• ⁽⁵⁾	NA	NA	NA	NA	NOAEL	5.0E + 1 ⁽¹⁷⁾	NOAEL	5.0E + 1 ⁽¹⁷⁾
2-Butanone	2.2E + 6 ⁽¹⁾	• ⁽⁵⁾	2.2E + 6 ⁽¹⁾	NA	NA	1.0E + 1 ⁽¹³⁾	LD50	2.2E + 2 ⁽¹⁷⁾	LD50	2.2E + 2 ⁽¹⁷⁾
2-Methylnaphthalene	3.3E + 2 ⁽¹⁾	• ⁽⁵⁾	3.3E + 2 ⁽¹⁾	NA	NA	2.3E+0 ⁽¹³⁾	NOAEL	4.0E + 2 ⁽²²⁾	NOAEL	4.0E + 2 ⁽²²⁾
2-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NOAEL	5.0E + 1 ⁽¹⁷⁾
2-Nitroaniline	4.3E + 1 ⁽¹⁾	• ⁽⁵⁾	NA	NA	NA	NA	LOAEL	1.3E + 1 ⁽¹⁷⁾	LOAEL	1.3E + 1 ⁽¹⁷⁾
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	6.3E+0 ⁽¹³⁾	NOAEL	3.7E + 0 ⁽²³⁾	NOAEL	3.7E + 0 ⁽²³⁾
4,4'-DDD	1.0E-3 ⁽³⁾	• ⁽⁵⁾	1.0E-3 ⁽⁴⁾	NA	NA	1.0E + 1 ⁽¹³⁾	NOAEL	8.0E-1 ⁽¹⁹⁾	LOAEL	2.8E-3 ⁽¹⁹⁾
4,4'-DDE	1.0E-3 ⁽³⁾	• ⁽⁵⁾	1.0E-3 ⁽⁴⁾	NA	NA	1.0E + 1 ⁽¹³⁾	NOAEL	8.0E-1 ⁽¹⁹⁾	LOAEL	2.8E-3 ⁽¹⁹⁾
4,4'-DDT	1.0E-3 ⁽³⁾	• ⁽⁵⁾	1.0E-3 ⁽⁴⁾	NA	NA	1.0E + 1 ⁽¹³⁾	NOAEL	8.0E-1 ⁽¹⁹⁾	LOAEL	2.8E-3 ⁽¹⁹⁾
4,6-Dinitro-2-methylphenol	8.8E + 1 ⁽¹⁾	• ⁽⁵⁾	NA	NA	NA	NA	NOAEL	1.0E + 1 ⁽²⁴⁾	NOAEL	1.0E + 1 ⁽²⁴⁾
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NOAEL	2.2E + 2 ⁽¹⁹⁾	NOAEL	2.2E + 2 ⁽¹⁹⁾
4-Methyl-2-pentanone	NA	NA	NA	NA	NA	1.0E + 1 ⁽¹³⁾	NOAEL	2.5E + 2 ⁽¹⁹⁾	NOAEL	2.5E + 2 ⁽¹⁹⁾
4-Methylphenol	1.3E + 3 ⁽¹⁾	• ⁽⁵⁾	1.3E + 3 ⁽⁴⁾	NA	NA	NA	NOAEL	6.0E + 1 ⁽²⁵⁾	NOAEL	6.0E + 1 ⁽²⁵⁾
Acenaphthene	2.3E + 1 ⁽²⁾	• ⁽⁵⁾	2.3E + 1 ⁽²⁾	NA	NA	2.4E+0 ⁽¹³⁾	NOAEL	1.8E + 2 ⁽¹⁷⁾	NOAEL	1.8E + 2 ⁽¹⁷⁾
Acenaphthylene	2.3E + 2 ⁽¹⁾	• ⁽⁵⁾	2.3E + 2 ⁽¹⁾	NA	NA	2.2E+0 ⁽¹³⁾	NOAEL	1.8E + 2 ⁽²⁶⁾	NOAEL	1.8E + 2 ⁽²⁶⁾
Acetone	NA	NA	4.9E + 6 ⁽¹⁾	NA	NA	6.1E+0 ⁽¹³⁾	NOAEL	1.0E + 2 ⁽¹⁹⁾	NOAEL	1.0E + 2 ⁽¹⁹⁾
Aldrin	3.0E-2 ⁽⁴⁾	• ⁽⁵⁾	3.0E-2 ⁽⁴⁾	NA	NA	1.0E + 1 ⁽¹³⁾	NOAEL	2.0E-1 ⁽¹⁹⁾	NOAEL	2.0E-1 ⁽¹⁹⁾
Alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NOAEL	4.0E + 0 ⁽¹⁹⁾
Alpha-Chlordane	4.3E-3 ⁽⁴⁾	• ⁽⁵⁾	1.3E + 1 ⁽¹⁾	NA	NA	1.0E + 1 ⁽¹³⁾	NOAEL	4.8E + 0 ⁽¹⁹⁾	NOAEL	2.1E + 0 ⁽¹⁹⁾
Aluminum	8.7E + 1 ⁽⁴⁾	2.7E + 4 ⁽⁶⁾	8.7E + 1 ⁽⁴⁾	2.7E + 4 ⁽⁶⁾	5.0E + 1 ⁽¹²⁾	NA	NOAEL	5.0E + 1 ⁽⁴⁴⁾	NOAEL	1.1E + 2 ⁽¹⁹⁾

TABLE 3-17 (Continued)
SUMMARY OF BENCHMARK VALUES USED TO IDENTIFY ECOLOGICAL CONTAMINANTS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Chemicals	Onsite Surface Water (ug/L)	Onsite Sediment (mg/kg)	Thames River/ Goss Cove Surface Water (ug/L)	Thames River/ Goss Cove Sediment (mg/kg)	Terrestrial Vegetation (mg/kg)	Soil Invertebrates (mg/kg and mg/L)	Mammal Endpoint	Mammals Test Result (mg/kg/d)	Bird Endpoint	Bird Test Result (mg/kg/d)
Anthracene	1.3E + 2 ⁽¹⁾	• ⁽⁵⁾	1.3E + 2 ⁽¹⁾	• ⁽⁵⁾	NA	1.9E + 0 ⁽¹³⁾	NOAEL	1.0E + 3 ⁽¹⁷⁾	NOAEL	1.0E + 3 ⁽¹⁷⁾
Antimony	NA	NA	NA	6.4E + 1 ⁽⁶⁾	5.0E + 0 ⁽¹²⁾	NA	LOAEL	1.3E + 0 ⁽¹⁹⁾	LOAEL	1.3E + 0 ⁽¹⁹⁾
Aroclor-1248	NA	NA	1.4E - 2 ⁽⁴⁾	• ⁽⁵⁾	NA	1.0E + 1 ⁽¹³⁾	LOAEL	1.0E - 1 ⁽¹⁹⁾	LOAEL	1.0E - 1 ⁽¹⁹⁾
Aroclor-1254	NA	NA	1.4E - 2 ⁽⁴⁾	• ⁽⁵⁾	4.0E + 1 ⁽¹²⁾	1.0E + 1 ⁽¹³⁾	LOAEL	1.4E + 0 ⁽¹⁹⁾	LOAEL	1.8E + 0 ⁽¹⁹⁾
Aroclor-1260	1.4E - 2 ⁽³⁾	• ⁽⁵⁾	1.4E - 2 ⁽⁴⁾	• ⁽⁵⁾	4.0E + 1 ⁽¹²⁾	1.0E + 1 ⁽¹³⁾	LOAEL	1.4E + 0 ⁽¹⁹⁾	LOAEL	1.8E + 0 ⁽¹⁹⁾
Arsenic	1.8E + 2 ⁽³⁾	6.0E + 0 ⁽⁸⁾	NA	6.0 + 0 ⁽⁶⁾	1.0E + 1 ⁽¹²⁾	NA	LOAEL	1.3E + 0 ⁽¹⁹⁾	NOAEL	5.1E + 1 ⁽¹⁹⁾
Barium	3.9E + 0 ⁽²⁾	2.0E + 1 ⁽⁹⁾	5.0E + 2 ⁽¹⁰⁾	• ⁽⁵⁾	5.0E + 2 ⁽¹²⁾	NA	NOAEL	5.1E + 0 ⁽¹⁹⁾	NOAEL	2.1E + 2 ⁽¹⁹⁾
Benzene	NA	NA	NA	NA	NA	8.9E + 0 ⁽¹³⁾	LOAEL	2.6E + 2 ⁽¹⁹⁾	LOAEL	2.6E + 2 ⁽¹⁹⁾
Benzo(a)anthracene	1.6E + 1 ⁽¹¹⁾	• ⁽⁵⁾	1.6E + 1 ⁽¹¹⁾	• ⁽⁵⁾	NA	1.0E + 1 ⁽¹³⁾	LOAEL	1.0E + 1 ⁽²⁷⁾	LOAEL	1.0E + 1 ⁽²⁷⁾
Benzo(a)pyrene	1.0E - 2 ⁽²⁾	• ⁽⁵⁾	1.0E - 2 ⁽²⁾	• ⁽⁵⁾	NA	1.0E + 1 ⁽¹³⁾	LOAEL	1.0E + 1 ⁽¹⁹⁾	LOAEL	1.0E + 1 ⁽¹⁹⁾
Benzo(b)fluoranthene	3.0E + 0 ⁽¹¹⁾	• ⁽⁵⁾	3.0E + 0 ⁽¹¹⁾	• ⁽⁵⁾	NA	1.0E + 1 ⁽¹³⁾	LOAEL	1.0E + 1 ⁽²⁷⁾	LOAEL	1.0E + 1 ⁽²⁷⁾
Benzo(g,h,i)perylene	3.0E + 0 ⁽¹¹⁾	• ⁽⁵⁾	3.0E + 0 ⁽¹¹⁾	• ⁽⁵⁾	NA	1.0E + 1 ⁽¹³⁾	LOAEL	1.0E + 1 ⁽²⁷⁾	LOAEL	1.0E + 1 ⁽²⁷⁾
Benzo(k)fluoranthene	1.0E + 0 ⁽¹¹⁾	• ⁽⁵⁾	1.0E + 0 ⁽¹¹⁾	• ⁽⁵⁾	NA	1.0E + 1 ⁽¹³⁾	LOAEL	1.0E + 1 ⁽²⁷⁾	LOAEL	1.0E + 1 ⁽²⁷⁾
Benzoic acid	2.0E + 4 ⁽¹¹⁾	• ⁽⁵⁾	2.0E + 4 ⁽¹¹⁾	• ⁽⁵⁾	NA	9.1E + 0 ⁽¹³⁾	NOAEL	8.0E + 1 ⁽¹⁷⁾	NOAEL	8.0E + 1 ⁽¹⁷⁾
Benzyl alcohol	NA	NA	NA	NA	NA	NA	NA	NA	NOAEL	8.0E + 1 ⁽²⁸⁾
Beryllium	NA	NA	NA	NA	1.0E + 1 ⁽¹²⁾	NA	NOAEL	6.6E - 1 ⁽¹⁹⁾	NOAEL	6.6E - 1 ⁽¹⁹⁾
Beta-BHC	6.2E + 2 ⁽¹⁾	• ⁽⁵⁾	NA	NA	NA	NA	NOAEL	4.0E + 0 ⁽¹⁹⁾	NOAEL	4.0E + 0 ⁽¹⁹⁾
Bis(2-ethylhexyl)phthalate	3.2E + 1 ⁽²⁾	• ⁽⁵⁾	3.2E + 1 ⁽²⁾	• ⁽⁵⁾	NA	NA	NOAEL	1.8E + 1 ⁽¹⁹⁾	NOAEL	1.1E + 0 ⁽¹⁹⁾
Boron	NA	NA	NA	NA	5.0E - 1 ⁽¹²⁾	NA	NOAEL	1.8E + 1 ⁽¹⁷⁾	NOAEL	1.8E + 1 ⁽¹⁷⁾
Bromodichloromethane	NA	NA	NA	NA	NA	4.9E - 1 ⁽¹³⁾	LOAEL	1.8E + 1 ⁽¹⁷⁾	LOAEL	1.8E + 1 ⁽¹⁷⁾
Bromomethane	NA	NA	NA	NA	NA	2.7E + 0 ⁽¹³⁾	NOAEL	1.4E + 0 ⁽¹⁷⁾	NOAEL	1.4E + 0 ⁽¹⁷⁾
Butylbenzylphthalate	1.9E + 1 ⁽²⁾	• ⁽⁵⁾	1.9E + 1 ⁽²⁾	• ⁽⁵⁾	NA	NA	NOAEL	1.6E + 2 ⁽¹⁷⁾	NOAEL	1.6E + 2 ⁽¹⁷⁾
Cadmium	6.6E - 1 ⁽³⁾	6.0E - 1 ⁽⁷⁾	9.3E + 0 ⁽⁴⁾	1.2E + 0 ⁽¹¹⁾	3.0E + 0 ⁽¹²⁾	5.0E + 1 ⁽¹⁴⁾	LOAEL	2.5E + 0 ⁽¹⁹⁾	NOAEL	1.5E + 0 ⁽¹⁹⁾
Carbazole	1.2E + 3 ⁽¹⁾	• ⁽⁵⁾	1.2E + 3 ⁽¹⁾	• ⁽⁵⁾	NA	4.1E + 0 ⁽¹³⁾	LOAEL	1.0E + 1 ⁽²⁷⁾	LOAEL	1.0E + 1 ⁽²⁷⁾
Carbon disulfide	5.3E + 3 ⁽¹⁾	• ⁽⁵⁾	5.3E + 3 ⁽¹⁾	• ⁽⁵⁾	NA	4.2E + 0 ⁽¹³⁾	NOAEL	1.1E + 1 ⁽¹⁷⁾	NOAEL	1.1E + 1 ⁽¹⁷⁾
Chlorobenzene	2.0E + 3 ⁽¹⁾	• ⁽⁵⁾	NA	NA	NA	3.8E + 0 ⁽¹³⁾	NOAEL	2.7E + 1 ⁽¹⁷⁾	NOAEL	2.7E + 1 ⁽¹⁷⁾
Chloroform	NA	NA	NA	NA	NA	7.5E + 0 ⁽¹³⁾	NOAEL	1.5E + 2 ⁽¹⁹⁾	NOAEL	1.5E + 2 ⁽¹⁹⁾
Chloromethane	NA	NA	NA	NA	NA	6.8E + 0 ⁽¹³⁾	NOAEL	3.4E + 1 ⁽²⁹⁾	NOAEL	3.4E + 1 ⁽²⁹⁾
Chromium	1.1E + 1 ⁽⁴⁾	2.6E + 1 ⁽⁷⁾	NA	8.1E + 1 ⁽¹¹⁾	1.0E + 0 ⁽¹²⁾	2.5E + 1 ⁽¹³⁾	LOAEL	4.6E + 0 ⁽¹⁹⁾	NOAEL	1.0E + 0 ⁽¹⁹⁾
Chrysene	1.6E + 1 ⁽¹¹⁾	• ⁽⁵⁾	1.6E + 1 ⁽⁴⁾	• ⁽⁵⁾	NA	NA	LOAEL	1.0E + 1 ⁽²⁷⁾	LOAEL	1.0E + 1 ⁽²⁷⁾

TABLE 3-17 (Continued)
SUMMARY OF BENCHMARK VALUES USED TO IDENTIFY ECOLOGICAL CONTAMINANTS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Chemicals	Onsite Surface Water (ug/L)	Onsite Sediment (mg/kg)	Thames River/ Goss Cove Surface Water (ug/L)	Thames River/ Goss Cove Sediment (mg/kg)	Terrestrial Vegetation (mg/kg)	Soil Invertebrates (mg/kg and mg/L)	Mammal Endpoint	Mammals Test Result (mg/kg/d)	Bird Endpoint	Bird Test Result (mg/kg/d)
Cis-1,3-dichloropropene	NA	NA	NA	NA	NA	1.0E+1 (13)	NOAEL	3.0E+0 (30)	NOAEL	3.0E+0 (30)
Cobalt	3.0E+0 (2)	5.0E+1 (8)	NA	5.0E+1 (8)	2.0E+1 (12)	NA	NOAEL	5.0E+0 (31)	NOAEL	5.0E+0 (31)
Copper	4.8E+0 (3)	1.6E+1 (7)	2.4E+0 (4)	3.4E+1 (11)	1.0E+2 (12)	3.0E+1 (15)	NOAEL	6.8E+1 (19)	NOAEL	3.3E+1 (19)
Cyanide	5.2E+0 (3)	1.0E-1 (9)	1.0E+0 (4)	• (5)	NA	NA	LOAEL	6.8E+1 (19)	LOAEL	6.8E+1 (19)
Delta-BHC	4.1E+2 (1)	• (5)	NA	NA	NA	NA	NOAEL	4.0E+0 (19)	NOAEL	4.0E+0 (19)
Di-n-butylphthalate	3.3E+1 (2)	• (5)	3.3E+1 (2)	• (5)	2.0E+2 (12)	NA	NOAEL	5.5E+2 (19)	LOAEL	1.1E+0 (19)
Di-n-octylphthalate	6.2E+1 (1)	• (3)	6.2E+1 (1)	• (3)	NA	NA	NOAEL	5.5E+2 (32)	NOAEL	5.5E+2 (32)
Dibenzo(a,h)anthracene	9.0E+0 (1)	• (5)	9.0E+0 (1)	• (5)	NA	1.0E+1 (13)	LOAEL	1.0E+1 (27)	LOAEL	1.0E+1 (27)
Dibenzofuran	2.0E+1 (2)	• (5)	2.0E+1 (2)	• (5)	NA	2.3E+0 (13)	LOAEL	1.0E+1 (27)	LOAEL	1.0E+1 (27)
Dieldrin	1.8E-3 (4)	• (5)	1.8E-3 (4)	• (5)	NA	5.3E+0 (13)	LOAEL	2.0E-1 (19)	NOAEL	7.7E-2 (19)
Diethyl phthalate	2.2E+2 (2)	• (5)	NA	NA	NA	NA	NOAEL	4.8E+3 (19)	NOAEL	4.8E+3 (19)
Endosulfan I	5.1E-2 (4)	• (5)	NA	NA	NA	7.9E+0 (13)	NOAEL	1.5E+0 (19)	NOAEL	1.0E+1 (19)
Endosulfan II	5.1E-2 (4)	• (5)	5.1E-2 (4)	• (5)	NA	7.9E+0 (13)	NOAEL	1.5E+0 (19)	NOAEL	1.0E+1 (19)
Endosulfan sulfate	5.1E-2 (4)	• (5)	NA	NA	NA	7.9E+0 (13)	NOAEL	1.5E+0 (33)	NOAEL	1.0E+1 (33)
Endrin	2.3E-3 (3)	• (5)	1.0E-2 (2)	• (5)	NA	1.0E+1 (13)	LOAEL	9.2E-1 (19)	NOAEL	3.0E-1 (19)
Endrin aldehyde	2.3E-3 (3)	• (5)	1.0E-2 (2)	• (5)	NA	1.0E+1 (13)	LOAEL	9.2E-1 (34)	NOAEL	3.0E-1 (34)
Endrin ketone	2.3E-3 (3)	• (5)	1.0E-2 (2)	• (5)	NA	1.0E+1 (13)	LOAEL	9.2E-1 (34)	NOAEL	3.0E-1 (34)
Ethylbenzene	2.8E+2 (2)	• (5)	NA	NA	NA	2.9E+0 (13)	LOAEL	4.1E+2 (17)	LOAEL	4.1E+2 (17)
Fluoranthene	8.1E+0 (4)	• (5)	8.1E+0 (4)	• (5)	NA	1.0E+1 (13)	NOAEL	1.3E+2 (35)	NOAEL	1.3E+2 (35)
Fluorene	3.9E+0 (4)	• (5)	3.9E+0 (4)	• (5)	NA	2.2E+0 (13)	NOAEL	1.3E+2 (17)	NOAEL	1.3E+2 (17)
Gamma-BHC	8.0E-2 (1)	• (5)	8.0E-2 (1)	• (5)	NA	NA	NOAEL	8.0E+0 (19)	LOAEL	2.0E+1 (19)
Gamma-Chlordane	4.3E-3 (3)	• (5)	4.3E-3 (4)	• (5)	NA	1.0E+1 (13)	NOAEL	4.8E+0 (19)	NOAEL	2.1E+0 (19)
Heptachlor	3.8E-3 (3)	• (5)	6.8E-3 (2)	• (5)	NA	4.2E+0 (13)	NOAEL	8.0E-1 (19)	NOAEL	8.0E-1 (19)
Heptachlor epoxide	3.8E-3 (3)	• (5)	NA	NA	NA	4.2E+0 (13)	LEL	3.0E-4 (17)	LEL	3.0E-4 (17)
Indeno(1,2,3-cd)pyrene	3.0E+0 (1)	• (5)	3.0E+0 (1)	• (5)	NA	1.0E+1 (13)	LOAEL	1.0E+1 (27)	LOAEL	1.0E+1 (27)
Iron	1.0E+3 (4)	2.0E+6 (7)	8.8E+4	• (5)	NA	NA	NA	NA	NA	NA
Lead	1.3E+0 (3)	3.1E+1 (7)	8.1E+0 (4)	4.7E+1 (11)	5.0E+1 (12)	5.9E+1 (16)	NOAEL	8.0E+0 (19)	NOAEL	3.9E+0 (19)
Manganese	8.0E+1 (2)	4.6E+2 (7)	NA	1.8E+3 (11)	5.0E+2 (12)	NA	NOAEL	8.8E+1 (19)	NOAEL	8.8E+1 (19)
Mercury	1.2E-2 (3)	2.0E-1 (7)	1.1E+0 (4)	1.5E-1 (11)	3.0E-1 (12)	2.2E+0 (15)	NOAEL	1.3E+1 (19)	LOAEL	6.4E-2 (19)

TABLE 3-17 (Continued)
SUMMARY OF BENCHMARK VALUES USED TO IDENTIFY ECOLOGICAL CONTAMINANTS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Chemicals	Onsite Surface Water (ug/L)	Onsite Sediment (mg/kg)	Thames River/ Goss Cove Surface Water (ug/L)	Thames River/ Goss Cove Sediment (mg/kg)	Terrestrial Vegetation (mg/kg)	Soil Invertebrates (mg/kg and mg/L)	Mammal Endpoint	Mammals Test Result (mg/kg/d)	Bird Endpoint	Bird Test Result (mg/kg/d)
Methoxychlor	3.0E-2 (3)	• (5)	NA	NA	NA	3.2E+0 (13)	NOAEL	4.0E+0 (19)	NOAEL	4.0E+0 (19)
Methylene chloride	2.2E+4 (1)	• (5)	2.2E+4 (1)	• (5)	NA	6.8E+0 (13)	NOAEL	5.9E+0 (19)	NOAEL	5.9E+0 (19)
Naphthalene	2.4E+1 (2)	• (5)	2.4E+1 (2)	• (5)	NA	3.0E+0 (13)	NOAEL	4.0E+2 (38)	NOAEL	4.0E+2 (38)
Nickel	8.8E-2 (3)	1.0E+1 (7)	NA	5.2E+1 (11)	3.0E+1 (12)	4.0E+2 (14)	NOAEL	4.0E+1 (19)	NOAEL	7.7E+1 (19)
OCDD	1.2E+1 (1)	• (5)	NA	NA	NA	NA	NOAEL	1.0E-6 (37)	NOAEL	1.4E-5 (37)
OCDF	2.0E+1 (2)	• (5)	NA	NA	NA	NA	NOAEL	4.8E-1 (38)	NOAEL	4.8E-1 (38)
Pentachlorophenol	5.7E+0 (3)	• (5)	NA	NA	NA	NA	NOAEL	3.0E+0 (17)	NOAEL	3.0E+0 (17)
Phenanthrene	6.3E+0 (4)	• (5)	6.3E+0 (4)	• (5)	NA	1.9E+0 (13)	LD50	1.3E+2 (39)	LD50	1.3E+2 (39)
Phenol	4.1E+3 (1)	• (5)	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	3.3E+1 (1)	• (5)	3.3E+1 (4)	• (5)	NA	1.0E+1 (13)	NOAEL	7.5E+1 (40)	NOAEL	7.5E+1 (40)
Selenium	5.0E+0 (4)	1.0E-1 (6)	NA	NA	1.0E+0 (12)	NA	LOAEL	7.5E-1 (19)	NOAEL	4.0E-1 (19)
Silver	NA	4.5E+0 (6)	NA	1.0E+0 (11)	2.0E+0 (12)	NA	NOAEL	1.4E+2 (17)	NOAEL	1.4E+2 (17)
Styrene	NA	NA	NA	NA	NA	2.8E+0 (13)	NOAEL	2.0E+2 (17)	NOAEL	2.0E+2 (17)
Tetrachloroethene	1.3E+2 (2)	• (5)	1.3E+2 (2)	• (5)	NA	7.0E+0 (13)	NOAEL	1.4E+1 (41)	NOAEL	1.4E+1 (41)
Thallium	NA	NA	NA	NA	1.0E+0 (12)	NA	LOAEL	7.4E-1 (19)	LOAEL	7.4E-1 (19)
Toluene	1.3E+2 (2)	• (5)	NA	NA	2.0E+2 (12)	3.5E+0 (13)	LOAEL	2.6E+2 (19)	LOAEL	2.6E+2 (19)
Trans-1,3-dichloropropene	NA	NA	NA	NA	NA	1.0E+1 (13)	NOAEL	3.0E+0 (42)	NOAEL	3.0E+0 (42)
Trichloroethene	3.5E+2 (2)	• (5)	3.5E+2 (2)	• (5)	NA	5.6E+0 (13)	LOAEL	7.0E+1 (19)	LOAEL	7.0E+1 (19)
Vanadium	NA	• (5)	NA	NA	2.0E+0 (12)	NA	LOAEL	2.1E+0 (19)	NOAEL	1.1E+1 (19)
Vinyl acetate	NA	NA	NA	NA	NA	NA	NOAEL	4.8E+2 (43)	NOAEL	4.8E+2 (43)
Xylenes, total	NA	• (5)	NA	NA	1.0E+2 (12)	NA	NOAEL	2.1E+0 (19)	NOAEL	2.1E+0 (19)
Zinc	1.2E-2 (3)	1.2E+2 (7)	8.1E+1 (4)	1.5E+2 (11)	5.0E+1 (12)	5.0E+3 (14)	NOAEL	1.6E+2 (19)	LOAEL	3.0E+2 (19)

- NA Not Applicable; chemical not present in surface water, sediment, or soil or not toxic to receptor
 1 14 day chronic NOEL for fish derived using ECOSAR (USEPA, 1994a)
 2 chronic value taken from ECOTOX (USEPA, 1995)
 3 State of Connecticut Chronic AWQC; for copper and zinc, state criteria based on water hardness of 50 mgCaCO₃/L used.
 4 Federal CAWQC
 5 Site-specific benchmarks based on EqP using Site-specific TOC and benchmark for surface water
 6 Washington State Dept. of Ecology (1994)
 7 OME (1992)
 8 OME (1988)

TABLE 3-17 (Continued)
SUMMARY OF BENCHMARK VALUES USED TO IDENTIFY ECOLOGICAL CONTAMINANTS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

9	Region V EPA
10	ACQUIRE (USEPA, 1995b)
11	ERL (Long et al., 1995)
12	Will and Suter, 1994
13	earthworm LC50/100; LC50 derived using ECOSAR (USEPA, 1994)
14	Malecki et. al, 1982
15	Bouche et. al, 1987
16	Neuhauser et. al, 1985
17	USEPA, 1995f
18	NOAEL for 1,1,1- Trichloroethane from Opresko, et. al, 1994
19	Opresko, et. al, 1994
20	NOAEL for TCDD used from Opresko et. al, 1994
21	NOAEL for 1,2, Dichlorobenzene from USEPA, 1995f
22	NOAEL for Napthalene from ATSDR, 1993
23	NOAEL for Benzidine used from ATSDR, 1990
24	ATSDR, 1994
25	NOAEL for phenol used from USEPA, 1995f
26	NOAEL for Acenaphthene used from Opresko, et. al, 1994
27	LOAEL for Benzo(a)pyrene used from Opresko, et. al, 1994
28	NOAEL for Benzoic Acid used from USEPA, 1995f
29	ATSDR, 1990
30	NOAEL for 1,3-Dichloropropene used from USEPA, 1995f
31	ATSDR, 1992
32	NOAEL for Di-n-butyl phthalate used from Opresko et. al, 1994
33	NOAEL for Enosulfan used from Opresko, et. al, 1994
34	NOAEL for Endrin used from Opresko, et. al, 1994
35	NOAEL for Fluorene used from USEPA, 1995f
36	ATSDR, 1994
37	NOAEL for TCDD used from Opresko et. al, 1994
38	NOAEL for PeDBF used from Opresko et al., 1994
39	Fed. Reg., 1989
40	USEPA, 1989
41	NOAEL for 1,1,2,2- Tetrachloroethylene used from Opresko, et. al, 1994
42	NOAEL for 1,3 - Dichloropropene used from USEPA, 1995f
43	ATSDR, 1992
44	McCormack, et al., 1979

TABLE 3-17 (Continued)
SUMMARY OF BENCHMARK VALUES USED TO IDENTIFY ECOLOGICAL CONTAMINANTS OF CONCERN
NSB-NLON, GROTON, CONNECTICUT

Site-specific criteria, based on the following equations, used to calculate chronic AWQC for Ni, Cd, and Pb:

Equation for calculation of Chronic Hardness Dependent Freshwater Metals Criteria

Metal	Mc	Bc	CCF
Cadmium	0.7852	-3.49	hardness dependent (see below)
Nickel	0.846	1.1645	0.997
Lead	1.273	-4.705	hardness dependent (see below)

Equations for calculation of Chronic Conversion Factor (CCF) for cadmium and lead

Cadmium $CCF = 1.10672 \cdot [\ln(\text{hardness}) \cdot (0.041538)]$

Lead $CCF = 1.46203 \cdot [\ln(\text{hardness}) \cdot (0.145712)]$

TABLE 3-18

BACKGROUND CONCENTRATIONS - SURFACE WATER⁽¹⁾
THAMES RIVER
NSB-NLON, GROTON, CONNECTICUT

Analyte	Background Concentration ($\mu\text{g/L}$)
Aluminum	1
Barium	20
Boron	4,500
Cadmium	0.11
Calcium	410,000
Chromium	0.05
Iron	3
Lead	0.03
Magnesium	1,350,000
Manganese	2
Mercury	0.2
Potassium	390,000
Sodium	10,500,000
Vanadium	2
Zinc	10

- 1 Background concentrations established using data taken from USGS Water-Supply Paper 2254 "Study and Interpretation of the Chemical Characteristics of Natural Water" (Hem, 1985).

TABLE 3-19
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE HERRING GULL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	1	10	2.00E-02	1.79E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	1	10	1.00E-01	1.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	1	10	1.00E-01	3.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	1	10	1.00E-02	4.52E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	1	10	1.00E-01	8.57E+00
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	1	10	2.00E-03	4.38E-01
2-Methylnapthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	1	10	1.00E-01	3.70E-01
4,4'-DDD	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDE	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDT	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	1	10	1.00E-02	2.50E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	1	10	1.00E-02	1.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	1	10	1.00E-01	2.00E-02
Alpha-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Aluminum	Ringed Dove	Reprod.; NOAEL	1.11E+02	1	1	1	1	1	5	1	2.00E-01	2.23E+01
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	1	10	1.00E-02	1.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	1	10	4.00E-03	5.00E-03
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	1	10	2.00E-02	2.00E-03
Aroclor-1254	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Aroclor-1260	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Arsenic	Mallard Duck	Mortality; NOAEL	5.14E+01	1	5	1	1	1	5	1	4.00E-02	2.05E+00
Barium	Chick	Mortality; NOAEL	2.08E+02	10	5	1	1	1	5	1	4.00E-03	8.33E-01
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	1	10	2.00E-02	5.27E+00
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00

TABLE 3-19
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE HERRING GULL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	1	10	2.00E-02	1.32E-02
Bis(2-ethylexyl)phthalate	Ringed Dove	Reprod.; NOAEL	1.11E+00	1	1	1	1	1	5	1	2.00E-01	2.22E-01
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	1	1	10	1.00E-01	1.75E+00
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	1	10	2.00E-02	3.58E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	1	10	1.00E-02	1.40E-02
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	1	10	1.00E-02	1.59E+00
Cadmium	Mallard Duck	Reprod.; NOAEL	1.45E+00	1	1	1	1	1	5	1	2.00E-01	2.90E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Carbon disulfide	Rabbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	1	10	1.00E-01	1.10E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	1	1	10	1.00E-02	2.73E-01
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	1	10	1.00E-02	1.50E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	1	10	1.00E-02	3.36E-01
Chromium VI	Black Duck	Reprod.; NOAEL	1.00E+00	1	1	1	1	1	5	1	2.00E-01	2.00E-01
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	1	10	1.00E-02	5.00E-02
Copper	Chicken	Growth; NOAEL	3.32E+01	1	1	1	1	1	5	1	2.00E-01	6.64E+00
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	1	10	2.00E-02	1.37E+00
Di-n-butylphthalate	Ringed Dove	Reprod.; LOAEL	1.11E+00	1	1	1	5	1	5	1	4.00E-02	4.44E-02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dieldrin	Barn Owl	Reprod.; NOAEL	7.70E-02	1	1	1	1	1	5	1	2.00E-01	1.54E-02
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	1	10	1.00E-01	4.58E+02
Endosulfan II	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endosulfan sulfate	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endrin	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin aldehyde	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin ketone	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	1	10	2.00E-03	8.16E-01
Fluoranthene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	1	1	1	1	1	1	10	1.00E-01	1.25E+01
Fluorene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	1	10	1.00E-02	1.25E+00
Gamma-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	1	10	1.00E-01	8.00E-02
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	1	1	10	2.00E-03	5.92E-07

TABLE 3-19
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE HERRING GULL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Indeno(1,2,3-cd)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Lead	American Kestrel	Reprod.; NOAEL	3.85E+00	1	1	1	1	1	5	1	2.00E-01	7.70E-01
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	1	10	1.00E-01	8.80E+00
Mercury	Mallard Duck	Reprod.; LOAEL	6.40E-02	1	1	1	5	1	5	1	4.00E-02	2.56E-03
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	1	10	1.00E-01	4.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	1	10	1.00E-01	5.85E-01
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
Nickel	Mallard Duckling	Behavior; NOAEL	7.74E+01	1	1	1	1	1	5	1	2.00E-01	1.55E+01
OCDD	Pheasant	Reprod.; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	1	10	4.00E-04	5.13E-02
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	1	10	1.00E-02	7.50E-01
Selenium	Mallard Duck	Reprod.; NOAEL	4.00E-01	1	1	1	1	1	5	1	2.00E-01	8.00E-02
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	1	10	1.00E-01	1.40E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	1	1	10	1.00E-02	2.00E+00
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	1	10	1.00E-02	1.40E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	1	10	2.00E-03	1.48E-03
Toluene	Mouse	Reprod.; LOAEL	2.80E+02	1	1	1	5	1	1	10	2.00E-02	5.20E+00
Trans-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	1	10	2.00E-03	1.40E-01
Vanadium	Mallard Duck	Blood Chem.; NOAEL	1.14E+01	1	1	1	1	1	5	1	2.00E-01	2.28E+00
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	1	10	1.00E-01	4.77E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	1	10	1.00E-01	2.06E-01
Zinc	Mallard Duck	Blood Chem.; LOAEL	3.00E+02	10	1	1	5	1	5	1	4.00E-03	1.20E+00
2-Methylphenol	Rat	Red. Body Wt.; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
Alpha-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Gamma-BHC	Mallard Duck	Reproduction; LOAEL	2.00E+01	1	1	1	5	1	5	1	4.00E-02	8.00E-01
2,4,- Dimethylphenol	Mouse	Hemat. Changes; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
Beta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Delta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Endosulfan I	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	1	10	1.00E-01	3.00E-01
2-Nitroaniline	Rat	Spl. Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	1	10	1.00E-01	1.25E+00
4,6 - Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	1	10	1.00E-02	1.00E-01

TABLE 3-19
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE HERRING GULL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	1	10	1.00E-01	2.16E+01
Di-n-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	1	10	1.00E-01	5.50E+01
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
OCDF	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	1	10	1.00E-02	4.80E-03
1,2,3,4,6,7 - HCDD	Pheasant	Reproduction; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06
Benzyl Alcohol	Rat	Growth; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00

1 Final Uncertainty Factor = $(1/UF_a * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f * 1/UF_g)$

2 Derived Wildlife NOAEL = Laboratory Test Endpoint * Uncertainty Factor

UF_a = Subchronic Exposure Period

UF_b = Nonsensitive Endpoint

UF_c = Acute to Chronic LOAEL

UF_d = LOAEL to NOAEL

UF_e = Within Taxonomic Order

UF_f = Between Taxonomic Order

UF_g = Mammal to Bird

TABLE 3-20
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE RED-TAILED HAWK
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	1	10	2.00E-02	1.79E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	1	10	1.00E-01	1.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	1	10	1.00E-01	3.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	1	10	1.00E-02	4.52E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	1	10	1.00E-01	8.57E+00
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	1	10	2.00E-03	4.38E-01
2-Methylnaphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	1	10	1.00E-01	3.70E-01
4,4'-DDD	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDE	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDT	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	1	10	1.00E-02	2.50E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	1	10	1.00E-02	1.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	1	10	1.00E-01	2.00E-02
Alpha-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Aluminum	Ringed Dove	Reprod.; NOAEL	1.11E+02	1	1	1	1	1	5	1	2.00E-01	2.23E+01
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	1	10	1.00E-02	1.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	1	10	4.00E-03	5.00E-03
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	1	10	2.00E-02	2.00E-03
Aroclor-1254	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Aroclor-1260	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Arsenic	Mallard Duck	Mortality; NOAEL	5.14E+01	1	5	1	1	1	5	1	4.00E-02	2.05E+00
Barium	Chick	Mortality; NOAEL	2.08E+02	10	5	1	1	1	5	1	4.00E-03	8.33E-01
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	1	10	2.00E-02	5.27E+00
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	1	10	2.00E-02	1.32E-02

TABLE 3-20
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE RED-TAILED HAWK
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Bis(2-ethylexyl)phthalate	Ringed Dove	Reprod.; NOAEL	1.11E+00	1	1	1	1	1	5	1	2.00E-01	2.22E-01
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	1	1	10	1.00E-01	1.75E+00
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	1	10	2.00E-02	3.58E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	1	10	1.00E-02	1.40E-02
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	1	10	1.00E-02	1.59E+00
Cadmium	Mallard Duck	Reprod.; NOAEL	1.45E+00	1	1	1	1	1	5	1	2.00E-01	2.90E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Carbon disulfide	Rabbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	1	10	1.00E-01	1.10E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	1	1	10	1.00E-02	2.73E-01
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	1	10	1.00E-02	1.50E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	1	10	1.00E-02	3.36E-01
Chromium VI	Black Duck	Reprod.; NOAEL	1.00E+00	1	1	1	1	1	5	1	2.00E-01	2.00E-01
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	1	10	1.00E-02	5.00E-02
Copper	Chicken	Growth; NOAEL	3.32E+01	1	1	1	1	1	5	1	2.00E-01	6.64E+00
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	1	10	2.00E-02	1.37E+00
Di-n-butylphthalate	Ringed Dove	Reprod.; LOAEL	1.11E+00	1	1	1	5	1	5	1	4.00E-02	4.44E-02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dieldrin	Barn Owl	Reprod.; NOAEL	7.70E-02	1	1	1	1	1	5	1	2.00E-01	1.54E-02
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	1	10	1.00E-01	4.58E+02
Endosulfan II	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endosulfan sulfate	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endrin	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin aldehyde	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin ketone	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	1	10	2.00E-03	8.16E-01
Fluoranthene	Mouse	Red Bid Cell Ct.; NOAEL	1.25E+02	1	1	1	1	1	1	10	1.00E-01	1.25E+01
Fluorene	Mouse	Red Bid Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	1	10	1.00E-02	1.25E+00
Gamma-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	1	10	1.00E-01	8.00E-02
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	1	1	10	2.00E-03	5.92E-07
Indeno(1,2,3-d)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Lead	American Kestrel	Reprod.; NOAEL	3.85E+00	1	1	1	1	2	1	1	1.00E+00	3.85E+00

TABLE 3-20
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE RED-TAILED HAWK
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	1	10	1.00E-01	8.80E+00
Mercury	Mallard Duck	Reprod.; LOAEL	6.40E-02	1	1	1	5	1	1	1	2.00E-01	1.28E-02
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	1	10	1.00E-01	4.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	1	10	1.00E-01	5.85E-01
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
Nickel	Mallard Duckling	Behavior.; NOAEL	7.74E+01	1	1	1	1	1	5	1	2.00E-01	1.55E+01
OCDD	Pheasant	Reprod.; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	1	10	4.00E-04	5.13E-02
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	1	10	1.00E-02	7.50E-01
Selenium	Mallard Duck	Reprod.; NOAEL	4.00E-01	1	1	1	1	1	5	1	2.00E-01	8.00E-02
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	1	10	1.00E-01	1.40E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	1	1	10	1.00E-02	2.00E+00
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	1	10	1.00E-02	1.40E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	1	10	2.00E-03	1.48E-03
Toluene	Mouse	Reprod.; LOAEL	2.60E+02	1	1	1	5	1	1	10	2.00E-02	5.20E+00
Trans-1,3-Dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	1	10	2.00E-03	1.40E-01
Vanadium	Mallard Duck	Blood Chem.; NOAEL	1.14E+01	1	1	1	1	1	5	1	2.00E-01	2.28E+00
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	1	10	1.00E-01	4.77E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	1	10	1.00E-01	2.06E-01
Zinc	Mallard Duck	Blood Chem.; LOAEL	3.00E+02	10	1	1	5	1	5	1	4.00E-03	1.20E+00
2-Methylphenol	Rat	Hed. Body Wt.; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
Alpha-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Gamma-BHC	Mallard Duck	Reproduction; LOAEL	2.00E+01	1	1	1	5	1	5	1	4.00E-02	8.00E-01
2,4,- Dimethylphenol	Mouse	Hemat. Changes; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
Beta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Delta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Endosulfan I	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	1	10	1.00E-01	3.00E-01
2-Nitroaniline	Rat	Spl.Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	1	10	1.00E-01	1.25E+00
4,6 - Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	1	10	1.00E-02	1.00E-01
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	1	10	1.00E-01	2.16E+01
Di-n-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	1	10	1.00E-01	5.50E+01

TABLE 3-20
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE RED-TAILED HAWK
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
OCDF	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	1	10	1.00E-02	4.80E-03

1 Final Uncertainty Factor = $(1/UF_a * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f * 1/UF_g)$

2 Derived Wildlife NOAEL = Laboratory Test Endpoint * Uncertainty Factor

UF_a = Subchronic Exposure Period

UF_b = Nonsensitive Endpoint

UF_c = Acute to Chronic LOAEL

UF_d = LOAEL to NOAEL

UF_e = Within Taxonomic Order

UF_f = Between Taxonomic Order

UF_g = Mammal to Bird

TABLE 3-21
DERIVATION OF NO-OBSERVED-APARENT EFFECTS-LEVELS FOR THE RACCOON
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	5	1	4.00E-02	3.57E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	5	1	2.00E-01	2.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	5	1	2.00E-01	6.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	5	1	2.00E-02	9.04E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	5	1	2.00E-01	1.71E+01
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	5	1	4.00E-03	8.76E-01
2-Methylnaphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	5	1	2.00E-02	8.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	5	1	2.00E-01	7.40E-01
4,4'-DDD	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
4,4'-DDE	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
4,4'-DDT	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	5	1	2.00E-02	5.00E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	5	1	2.00E-02	3.50E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	5	1	2.00E-02	3.50E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	5	1	2.00E-02	2.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	5	1	2.00E-01	4.00E-02
Alpha-Chlordane	Mouse	Reprod.; NOAEL	4.58E+00	1	1	1	1	1	5	1	2.00E-01	9.16E-01
Aluminum	Rat	Reprod.; NOAEL	5.00E+01	1	1	1	1	1	5	1	2.00E-01	1.00E+01
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	5	1	2.00E-02	2.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	5	1	8.00E-03	1.00E-02
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	5	1	4.00E-02	4.00E-03
Aroclor-1254	Mouse	Reprod.; LOAEL	1.35E+00	1	1	1	5	1	5	1	4.00E-02	5.40E-02
Aroclor-1260	Mouse	Reprod.; LOAEL	1.35E+00	1	1	1	5	1	5	1	4.00E-02	5.40E-02
Arsenic	Mouse	Reprod.; LOAEL	1.26E+00	1	1	1	5	1	5	1	4.00E-02	5.04E-02
Barium	Rat	Growth; NOAEL	5.06E+00	1	1	1	1	1	5	1	2.00E-01	1.01E+00
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	5	1	4.00E-02	1.05E+01
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	5	1	2.00E-01	1.60E+01
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	5	1	4.00E-02	2.64E-02

TABLE 3-21
DERIVATION OF NO-OBSERVED-APARENT EFFECTS-LEVELS FOR THE RACCOON
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Bis(2-ethylexyl)phthalate	Mouse	Reprod.; NOAEL	1.83E+01	1	1	1	1	1	5	1	2.00E-01	3.66E+00
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	2	1	1	1.00E+00	1.75E+01
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	5	1	4.00E-02	7.16E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	5	1	2.00E-02	2.80E-02
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	5	1	2.00E-02	3.18E+00
Cadmium	Mouse	Reprod.; LOAEL	2.52E+00	1	1	1	5	1	5	1	4.00E-02	1.01E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Carbon disulfide	Rabbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	5	1	2.00E-01	2.20E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	2	1	1	1.00E-01	2.73E+00
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	5	1	2.00E-02	3.00E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	5	1	2.00E-02	6.72E-01
Chromium VI	Mouse	Reprod.; LOAEL	4.60E+00	1	1	1	5	1	5	1	4.00E-02	1.84E-01
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	5	1	2.00E-02	6.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	5	1	2.00E-02	1.00E-01
Copper	Rat	Reprod.; NOAEL	6.60E+01	1	1	1	1	1	5	1	2.00E-01	1.32E+01
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	5	1	4.00E-02	2.75E+00
Di-n-butylphthalate	Mouse	Reprod.; NOAEL	5.50E+02	1	1	1	1	1	5	1	2.00E-01	1.10E+02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Dieldrin	Rat	Reprod.; LOAEL	2.00E-01	1	1	1	5	1	5	1	4.00E-02	8.00E-03
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	5	1	2.00E-01	9.17E+02
Endosulfan II	Rat	Reprod.; NOAEL	1.50E+00	10	1	1	1	1	5	1	2.00E-02	3.00E-02
Endosulfan sulfate	Rat	Reprod.; NOAEL	1.50E+00	10	1	1	1	1	5	1	2.00E-02	3.00E-02
Endrin	Mouse	Reprod.; LOAEL	9.20E-01	1	1	1	5	1	5	1	4.00E-02	3.68E-02
Endrin aldehyde	Mouse	Reprod.; LOAEL	9.20E-01	1	1	1	5	1	5	1	4.00E-02	3.68E-02
Endrin ketone	Mouse	Reprod.; LOAEL	9.20E-01	1	1	1	5	1	5	1	4.00E-02	3.68E-02
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	5	1	4.00E-03	1.63E+00
Fluoranthene	Mouse	Red Bid Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	5	1	2.00E-02	2.50E+00
Fluorene	Mouse	Red Bid Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	5	1	2.00E-02	2.50E+00
Gamma-Chlordane	Mouse	Reprod.; NOAEL	4.58E+00	1	1	1	1	1	5	1	2.00E-01	9.16E-01
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	2	1	1	2.00E-02	5.92E-06
Indeno(1,2,3-Cd)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Lead	Rat	Reprod.; NOAEL	8.00E+00	1	1	1	1	1	5	1	2.00E-01	1.60E+00

TABLE 3-21
DERIVATION OF NO-OBSERVED-APARENT EFFECTS-LEVELS FOR THE RACCOON
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	5	1	2.00E-01	1.76E+01
Mercury	Mouse	Reprod.; NOAEL	1.32E+01	1	1	1	1	1	5	1	2.00E-01	2.64E+00
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	5	1	2.00E-01	8.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	5	1	2.00E-01	1.17E+00
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	5	1	2.00E-02	8.00E+00
Nickel	Rat	Reprod.; NOAEL	4.00E+01	1	1	1	1	1	5	1	2.00E-01	8.00E+00
OCDD	Rat	Reprod.; NOAEL	1.00E-06	1	1	1	1	1	5	1	2.00E-01	2.00E-07
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	5	1	8.00E-04	1.03E-01
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	5	1	2.00E-02	1.50E+00
Selenium	Mouse	Reprod.; LOAEL	7.50E-01	1	1	1	5	1	5	1	4.00E-02	3.00E-02
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	5	1	2.00E-01	2.80E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	2	1	1	1.00E-01	2.00E+01
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	5	1	2.00E-02	2.80E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	5	1	4.00E-03	2.96E-03
Toluene	Mouse	Reprod.; LOAEL	2.60E+02	1	1	1	5	1	5	1	4.00E-02	1.04E+01
Trans-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	5	1	2.00E-02	6.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	5	1	4.00E-03	2.80E-01
Vanadium	Rat	Reprod.; LOAEL	2.10E+00	1	1	1	5	1	5	1	4.00E-02	8.40E-02
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	5	1	2.00E-01	9.54E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	5	1	2.00E-01	4.12E-01
Zinc	Rat	Reprod.; NOAEL	1.60E+02	1	1	1	1	1	5	1	2.00E-01	3.20E+01
2,4-Dimethylphenol	Mouse	Hemat.Changes; NOAEL	5.00E+01	10	1	1	1	1	5	1	2.00E-02	1.00E+00
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	5	1	2.00E-01	1.20E+01
Beta BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	5	1	2.00E-02	8.00E-02
Delta BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	5	1	2.00E-02	8.00E-02
Endosulfan I	Rat	Reprod.; NOAEL	1.50E+00	10	1	1	1	1	5	1	2.00E-02	3.00E-02
Gamma BHC	Rat	Reproduction; NOAEL	8.00E+00	1	1	1	1	1	5	1	2.00E-01	1.60E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	5	1	2.00E-01	6.00E-01
2-Nitroaniline	Rat	Spl.Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	5	1	2.00E-01	2.50E+00
4,6 - Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	5	1	2.00E-02	2.00E-01
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	5	1	2.00E-01	4.32E+01
Di-N-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	5	1	2.00E-01	1.10E+02
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	5	1	2.00E-01	1.20E+01
OCDF	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	5	1	2.00E-02	9.60E-03
1,2,3,4,6,7 - HCDD	Rat	Reproduction; NOAEL	1.00E-06	1	1	1	1	1	5	1	2.00E-01	2.00E-07

TABLE 3-21
DERIVATION OF NO-OBSERVED-APARENT EFFECTS-LEVELS FOR THE RACCOON
NSB-NLON, GROTON, CONNECTICUT

- 1 Final Uncertainty Factor = $(1/UF_s * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f)$
2 Derived Wildlife NOEL = Laboratory Test Endpoint * Uncertainty Factor
 UF_s = Subchronic Exposure Period
 UF_b = Nonsensitive Endpoint
 UF_c = Acute to Chronic LOEL
 UF_d = LOEL to NOEL
 UF_e = Within Taxonomic Order
 UF_f = Mammal to Bird

TABLE 3-22
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE MALLARD
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	1	10	2.00E-02	1.79E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	1	10	1.00E-01	1.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	1	10	1.00E-01	3.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	1	10	1.00E-02	4.52E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	1	10	1.00E-01	8.57E+00
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	1	10	2.00E-03	4.38E-01
2-Methylnaphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	1	10	1.00E-01	3.70E-01
4,4'-DDD	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDE	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDT	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	1	10	1.00E-02	2.50E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	1	10	1.00E-02	1.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	1	10	1.00E-01	2.00E-02
Alpha-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Aluminum	Ringed Dove	Reprod.; NOAEL	1.11E+02	1	1	1	1	1	5	1	2.00E-01	2.23E+01
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	1	10	1.00E-02	1.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	1	10	4.00E-03	5.00E-03
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	1	10	2.00E-02	2.00E-03
Aroclor-1254	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Aroclor-1260	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Arsenic	Mallard Duck	Mortality; NOAEL	5.14E+01	1	5	1	1	1	1	1	2.00E-01	1.03E+01
Barium	Chick	Mortality; NOAEL	2.08E+02	10	5	1	1	1	5	1	4.00E-03	8.33E-01
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	1	10	2.00E-02	5.27E+00
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	1	10	2.00E-02	1.32E-02

TABLE 3-22
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE MALLARD
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Bis(2-ethylexyl)phthalate	Ringed Dove	Reprod.; NOAEL	1.11E+00	1	1	1	1	1	5	1	2.00E-01	2.22E-01
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	1	1	10	1.00E-01	1.75E+00
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	1	10	2.00E-02	3.58E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	1	10	1.00E-02	1.40E-02
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	1	10	1.00E-02	1.59E+00
Cadmium	Mallard Duck	Reprod.; NOAEL	1.45E+00	1	1	1	1	1	1	10	1.00E-01	1.45E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Carbon disulfide	Rabbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	1	10	1.00E-01	1.10E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	1	1	10	1.00E-02	2.73E-01
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	1	10	1.00E-02	1.50E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	1	10	1.00E-02	3.36E-01
Chromium VI	Black Duck	Reprod.; NOAEL	1.00E+00	1	1	1	1	1	1	1	1.00E+00	1.00E+00
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	1	10	1.00E-02	5.00E-02
Copper	Chicken	Growth; NOAEL	3.32E+01	1	1	1	1	1	5	1	2.00E-01	6.64E+00
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	1	10	2.00E-02	1.37E+00
Di-n-butylphthalate	Ringed Dove	Reprod.; LOAEL	1.11E+00	1	1	1	5	1	5	1	4.00E-02	4.44E-02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dieldrin	Barn Owl	Reprod.; NOAEL	7.70E-02	1	1	1	1	1	5	1	2.00E-01	1.54E-02
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	1	10	1.00E-01	4.58E+02
Endosulfan II	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endosulfan sulfate	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endrin	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	1	1	1.00E+00	3.00E-01
Endrin aldehyde	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	1	1	1.00E+00	3.00E-01
Endrin ketone	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	1	1	1.00E+00	3.00E-01
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	1	10	2.00E-03	8.16E-01
Fluoranthene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	1	1	1	1	1	1	10	1.00E-01	1.25E+01
Fluorene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	1	10	1.00E-02	1.25E+00
Gamma-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	1	10	1.00E-01	8.00E-02
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	1	1	10	2.00E-03	5.92E-07
Indeno(1,2,3-d)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Lead	American Kestrel	Reprod.; NOAEL	3.85E+00	1	1	1	1	1	5	1	2.00E-01	7.70E-01

TABLE 3-22
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE MALLARD
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	1	10	1.00E-01	8.80E+00
Mercury	Mallard Duck	Reprod.; LOAEL	6.40E-02	1	1	1	5	1	1	1	2.00E-01	1.28E-02
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	1	10	1.00E-01	4.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	1	10	1.00E-01	5.85E-01
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
Nickel	Mallard Duckling	Behavior.; NOAEL	7.74E+01	1	1	1	1	1	1	1	1.00E+00	7.74E+01
OCDD	Pheasant	Reprod.; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	1	10	4.00E-04	5.13E-02
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	1	10	1.00E-02	7.50E-01
Selenium	Mallard Duck	Reprod.; NOAEL	4.00E-01	1	1	1	1	1	1	1	1.00E+00	4.00E-01
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	1	10	1.00E-01	1.40E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	1	1	10	1.00E-02	2.00E+00
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	1	10	1.00E-02	1.40E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	1	10	2.00E-03	1.48E-03
Toluene	Mouse	Reprod.; LOAEL	2.60E+02	1	1	1	5	1	1	10	2.00E-02	5.20E+00
Trans-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	1	10	2.00E-03	1.40E-01
Vanadium	Mallard Duck	Blood Chem.; NOAEL	1.14E+01	1	1	1	1	1	1	1	1.00E+00	1.14E+01
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	1	10	1.00E-01	4.77E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	1	10	1.00E-01	2.06E-01
Zinc	Mallard Duck	Blood Chem.; LOAEL	3.00E+02	10	1	1	5	1	1	1	2.00E-02	6.00E+00
2,4,- Dimethylphenol	Mouse	Hemat. Changes; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
Beta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Delta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Endosulfan I	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Gamma-BHC	Mallard	Reproduction; LOAEL	2.00E+01	1	1	1	5	1	1	1	2.00E-01	4.00E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	1	10	1.00E-01	3.00E-01
2-Nitroaniline	Rat	Spl. Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	1	10	1.00E-01	1.25E+00
4,6 - Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	1	10	1.00E-02	1.00E-01
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	1	10	1.00E-01	2.16E+01
Di-n-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	1	10	1.00E-01	5.50E+01
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
OCDF	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	1	10	1.00E-02	4.80E-03
1,2,3,4,6,7 - HCDD	Pheasant	Reproduction; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06

TABLE 3-22

**DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE MALLARD
NSB-NLON, GROTON, CONNECTICUT**

1	Final Uncertainty Factor = $(1/UF_a * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f * 1/UF_g)$
2	Derived Wildlife NOAEL = Laboratory Test Endpoint * Uncertainty Factor
UF_a	= Subchronic Exposure Period
UF_b	= Nonsensitive Endpoint
UF_c	= Acute to Chronic LOAEL
UF_d	= LOAEL to NOAEL
UF_e	= Within Taxonomic Order
UF_f	= Between Taxonomic Order
UF_g	= Mammal to Bird

TABLE 3-23
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE BARRED OWL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	1	10	2.00E-02	1.79E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	1	10	1.00E-01	1.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	1	10	1.00E-01	3.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	1	10	1.00E-02	4.52E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	1	10	1.00E-01	8.57E+00
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	1	10	2.00E-03	4.38E-01
2-Methylnaphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	1	10	1.00E-01	3.70E-01
4,4'-DDD	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDE	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4,4'-DDT	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	1	5	1	4.00E-02	1.12E-04
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	1	10	1.00E-02	2.50E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	1	10	1.00E-02	1.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	1	10	1.00E-01	2.00E-02
Alpha-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Aluminum	Ringed Dove	Reprod.; NOAEL	1.11E+02	1	1	1	1	1	5	1	2.00E-01	2.23E+01

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TABLE 3-23
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE BARRED OWL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	1	10	1.00E-02	1.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	1	10	4.00E-03	5.00E-03
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	1	10	2.00E-02	2.00E-03
Aroclor-1254	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Aroclor-1260	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Arsenic	Mallard Duck	Mortality; NOAEL	5.14E+01	1	5	1	1	1	5	1	4.00E-02	2.05E+00
Barium	Chick	Mortality; NOAEL	2.08E+02	10	5	1	1	1	5	1	4.00E-03	8.33E-01
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	1	10	2.00E-02	5.27E+00
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	1	10	2.00E-02	1.32E-02
Bis(2-ethylexyl)phthalate	Ringed Dove	Reprod.; NOAEL	1.11E+00	1	1	1	1	1	5	1	2.00E-01	2.22E-01
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	1	1	10	1.00E-01	1.75E+00
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	1	10	2.00E-02	3.58E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	1	10	1.00E-02	1.40E-02

TABLE 3-23
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE BARRED OWL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	1	10	1.00E-02	1.59E+00
Cadmium	Mallard Duck	Reprod.; NOAEL	1.45E+00	1	1	1	1	1	5	1	2.00E-01	2.90E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Carbon disulfide	Rabbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	1	10	1.00E-01	1.10E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	1	1	10	1.00E-02	2.73E-01
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	1	10	1.00E-02	1.50E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	1	10	1.00E-02	3.36E-01
Chromium VI	Black Duck	Reprod.; NOAEL	1.00E+00	1	1	1	1	1	5	1	2.00E-01	2.00E-01
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	5	10	2.00E-03	1.00E-02
Copper	Chicken	Growth; NOAEL	3.32E+01	1	1	1	1	1	5	1	2.00E-01	6.64E+00
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	1	10	2.00E-02	1.37E+00
Di-n-butylphthalate	Ringed Dove	Reprod.; LOAEL	1.11E+00	1	1	1	5	1	5	1	4.00E-02	4.44E-02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dieldrin	Barn Owl	Reprod.; NOAEL	7.70E-02	1	1	1	1	2	1	1	1.00E+00	7.70E-02
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	1	10	1.00E-01	4.58E+02
Endosulfan II	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00

TABLE 3-23
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE BARRED OWL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Endosulfan sulfate	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endrin	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin aldehyde	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin ketone	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	1	10	2.00E-03	8.16E-01
Fluoranthene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	1	1	1	1	1	1	10	1.00E-01	1.25E+01
Fluorene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	1	10	1.00E-02	1.25E+00
Gamma-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	1	10	1.00E-01	8.00E-02
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	1	1	10	2.00E-03	5.92E-07
Indeno(1,2,3-Cd)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Lead	American Kestrel	Reprod.; NOAEL	3.85E+00	1	1	1	1	1	5	1	2.00E-01	7.70E-01
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	1	10	1.00E-01	8.80E+00
Mercury	Mallard Duck	Reprod.; LOAEL	6.40E-02	1	1	1	5	1	5	1	4.00E-02	2.56E-03
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	1	10	1.00E-01	4.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	1	10	1.00E-01	5.85E-01
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
Nickel	Mallard Duckling	Behavior; NOAEL	7.74E+01	1	1	1	1	1	5	1	2.00E-01	1.55E+01
OCDD	Pheasant	Reprod.; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06

TABLE 3-23
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE BARRED OWL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	1	10	4.00E-04	5.13E-02
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	1	10	1.00E-02	7.50E-01
Selenium	Mallard Duck	Reprod.; NOAEL	4.00E-01	1	1	1	1	1	5	1	2.00E-01	8.00E-02
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	1	10	1.00E-01	1.40E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	1	1	10	1.00E-02	2.00E+00
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	1	10	1.00E-02	1.40E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	1	10	2.00E-03	1.48E-03
Toluene	Mouse	Reprod.; LOAEL	2.60E+02	1	1	1	5	1	1	10	2.00E-02	5.20E+00
Trans-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	1	10	2.00E-03	1.40E-01
Vanadium	Mallard Duck	Blood Chem.; NOAEL	1.14E+01	1	1	1	1	1	5	1	2.00E-01	2.28E+00
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	1	10	1.00E-01	4.77E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	1	10	1.00E-01	2.06E-01
Zinc	Mallard Duck	Blood Chem.; LOAEL	3.00E+02	10	1	1	5	1	5	1	4.00E-03	1.20E+00
2,4,- Dimethylphenol	Mouse	Hemat. Changes; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
Beta BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Delta BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Endosulfan I	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00

TABLE 3-23
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE BARRED OWL
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Gamma BHC	Mallard	Reproduction; LOAEL	2.00E+01	1	1	1	5	1	1	1	2.00E-01	4.00E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	1	10	1.00E-01	3.00E-01
2-Nitroaniline	Rat	Spl. Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	1	10	1.00E-01	1.25E+00
4,6 - Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	1	10	1.00E-02	1.00E-01
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	1	10	1.00E-01	2.16E+01
Di-N-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	1	10	1.00E-01	5.50E+01
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
OCDF	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	1	10	1.00E-02	4.80E-03
1,2,3,4,6,7 - HCDD	Pheasant	Reproduction; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06

- 1 Final Uncertainty Factor = $(1/UF_a * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f)$
 2 Derived Wildlife NOAEL = Laboratory Test Endpoint * Uncertainty Factor
 UF_a = Subchronic Exposure Period
 UF_b = Nonsensitive Endpoint
 UF_c = Acute to Chronic LOAEL
 UF_d = LOAEL to NOAEL
 UF_e = Within Taxonomic Order
 UF_f = Mammal to Bird

TABLE 3-24
DERIVATION OF NO OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE CORMORANT
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	1	10	2.00E-02	1.79E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	1	10	1.00E-01	1.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	1	10	1.00E-01	3.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	1	10	1.00E-02	4.52E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	1	10	1.00E-01	8.57E+00
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	1	10	2.00E-03	4.38E-01
2-Methylnapthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	1	10	1.00E-01	3.70E-01
4,4'-DDD	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	2	1	1	2.00E-01	5.60E-04
4,4'-DDE	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	2	1	1	2.00E-01	5.60E-04
4,4'-DDT	Br. Pelican	Reprod.; LOAEL	2.80E-03	1	1	1	5	2	1	1	2.00E-01	5.60E-04
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	1	10	1.00E-02	2.50E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	1	10	1.00E-02	1.75E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	1	10	1.00E-02	1.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	1	10	1.00E-01	2.00E-02
Alpha-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Aluminum	Ringed Dove	Reprod.; NOAEL	1.11E+02	1	1	1	1	1	5	1	2.00E-01	2.23E+01
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	1	10	1.00E-02	1.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	1	10	4.00E-03	5.00E-03
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	1	10	2.00E-02	2.00E-03
Aroclor-1254	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Aroclor-1260	Pheasant	Reprod.; LOAEL	1.80E+00	1	1	1	5	1	5	1	4.00E-02	7.20E-02
Arsenic	Mallard Duck	Mortality; NOAEL	5.14E+01	1	5	1	1	1	5	1	4.00E-02	2.05E+00
Barium	Chick	Mortality; NOAEL	2.08E+02	10	5	1	1	1	5	1	4.00E-03	8.33E-01
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	1	10	2.00E-02	5.27E+00
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00

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TABLE 3-24
DERIVATION OF NO OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE CORMORANT
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	1	10	2.00E-02	1.32E-02
Bis(2-ethylexyl)phthalate	Ringed Dove	Reprod.; NOAEL	1.11E+00	1	1	1	1	1	5	1	2.00E-01	2.22E-01
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	1	1	10	1.00E-01	1.75E+00
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	1	10	2.00E-02	3.58E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	1	10	1.00E-02	1.40E-02
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	1	10	1.00E-02	1.59E+00
Cadmium	Mallard Duck	Reprod.; NOAEL	1.45E+00	1	1	1	1	1	5	1	2.00E-01	2.90E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Carbon disulfide	Habbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	1	10	1.00E-01	1.10E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	1	1	10	1.00E-02	2.73E-01
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	1	10	1.00E-02	1.50E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	1	10	1.00E-02	3.36E-01
Chromium VI	Black Duck	Reprod.; NOAEL	1.00E+00	1	1	1	1	1	5	1	2.00E-01	2.00E-01
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	1	10	1.00E-02	5.00E-02
Copper	Chicken	Growth; NOAEL	3.32E+01	1	1	1	1	1	5	1	2.00E-01	6.64E+00
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	1	10	2.00E-02	1.37E+00
Di-n-butylphthalate	Ringed Dove	Reprod.; LOAEL	1.11E+00	1	1	1	5	1	5	1	4.00E-02	4.44E-02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Dieldrin	Barn Owl	Reprod.; NOAEL	7.70E-02	1	1	1	1	1	5	1	2.00E-01	1.54E-02
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	1	10	1.00E-01	4.58E+02
Endosulfan II	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endosulfan sulfate	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Endrin	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin aldehyde	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Endrin ketone	Mallard Duck	Reprod.; NOAEL	3.00E-01	1	1	1	1	1	5	1	2.00E-01	6.00E-02
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	1	10	2.00E-03	8.16E-01
Fluoranthene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	1	1	1	1	1	1	10	1.00E-01	1.25E+01
Fluorene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	1	10	1.00E-02	1.25E+00
Gamma-Chlordane	Rd-winged Blk Bird	Mortality; NOAEL	2.14E+00	1	5	1	1	1	5	1	4.00E-02	8.56E-02
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	1	10	1.00E-01	8.00E-02
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	1	1	10	2.00E-03	5.92E-07

TABLE 3-24
DERIVATION OF NO OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE CORMORANT
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Indeno(1,2,3-d)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	1	10	2.00E-02	2.00E-01
Lead	American Kestrel	Reprod.; NOAEL	3.85E+00	1	1	1	1	1	5	1	2.00E-01	7.70E-01
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	1	10	1.00E-01	8.80E+00
Mercury	Mallard Duck	Reprod.; LOAEL	6.40E-02	1	1	1	5	1	5	1	4.00E-02	2.56E-03
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	1	10	1.00E-01	4.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	1	10	1.00E-01	5.85E-01
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	1	10	1.00E-02	4.00E+00
Nickel	Mallard Duckling	Behavior.; NOAEL	7.74E+01	1	1	1	1	1	5	1	2.00E-01	1.55E+01
OCDD	Pheasant	Reprod.; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	1	10	4.00E-04	5.13E-02
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	1	10	1.00E-02	7.50E-01
Selenium	Mallard Duck	Reprod.; NOAEL	4.00E-01	1	1	1	1	1	5	1	2.00E-01	8.00E-02
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	1	10	1.00E-01	1.40E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	1	1	10	1.00E-02	2.00E+00
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	1	10	1.00E-02	1.40E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	1	10	2.00E-03	1.48E-03
Toluene	Mouse	Reprod.; LOAEL	2.80E+02	1	1	1	5	1	1	10	2.00E-02	5.20E+00
Trans-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	1	10	1.00E-02	3.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	1	10	2.00E-03	1.40E-01
Vanadium	Mallard Duck	Blood Chem.; NOAEL	1.14E+01	1	1	1	1	1	5	1	2.00E-01	2.28E+00
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	1	10	1.00E-01	4.77E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	1	10	1.00E-01	2.06E-01
Zinc	Mallard Duck	Blood Chem.; LOAEL	3.00E+02	10	1	1	5	1	5	1	4.00E-03	1.20E+00
2-Methylphenol	Rat	Red. Body Wt.; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
Alpha-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Gamma-BHC	Mallard Duck	Reproduction; LOAEL	2.00E+01	1	1	1	5	1	5	1	4.00E-02	8.00E-01
2,4-Dimethylphenol	Mouse	Hemat. Changes; NOAEL	5.00E+01	10	1	1	1	1	1	10	1.00E-02	5.00E-01
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
Beta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Delta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	1	10	1.00E-02	4.00E-02
Endosulfan I	Gray Partridge	Reprod.; NOAEL	1.00E+01	1	1	1	1	1	5	1	2.00E-01	2.00E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	1	10	1.00E-01	3.00E-01
2-Nitroaniline	Rat	Spl.Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	1	10	1.00E-01	1.25E+00
4,6-Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	1	10	1.00E-02	1.00E-01

TABLE 3-24
DERIVATION OF NO OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE CORMORANT
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	1	10	1.00E-01	2.16E+01
Di-n-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	1	10	1.00E-01	5.50E+01
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	1	10	1.00E-01	6.00E+00
OCDF	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	1	10	1.00E-02	4.80E-03
1,2,3,4,6,7 - HCDD	Pheasant	Reproduction; NOAEL	1.40E-05	1	1	1	1	1	5	1	2.00E-01	2.80E-06
Benzyl Alcohol	Rat	Growth; NOAEL	8.00E+01	1	1	1	1	1	1	10	1.00E-01	8.00E+00

1 Final Uncertainty Factor = $(1/UF_a * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f * 1/UF_g)$

2 Derived Wildlife NOAEL = Laboratory Test Endpoint * Uncertainty Factor

UF_a = Subchronic Exposure Period

UF_b = Nonsensitive Endpoint

UF_c = Acute to Chronic LOAEL

UF_d = LOAEL to NOAEL

UF_e = Within Taxonomic Order

UF_f = Between Taxonomic Order

UF_g = Mammal to Bird

TABLE 3-25
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE SHORT-TAILED SHREW
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
1,1,2,2-Tetrachloroethane	Rat	Lvr & Kid Damage; LOAEL	8.93E+01	1	1	1	5	1	5	1	4.00E-02	3.57E+00
1,1,2-Trichloroethane	Mouse	Reprod.; NOAEL	1.00E+03	1	1	1	1	1	5	1	2.00E-01	2.00E+02
1,1-Dichloroethene	Rat	Liver Histology; NOAEL	3.00E+01	1	1	1	1	1	5	1	2.00E-01	6.00E+00
1,2-Dichloroethene (total)	Mouse	Blood Chem.; NOAEL	4.52E+02	10	1	1	1	1	5	1	2.00E-02	9.04E+00
1,4-Dichlorobenzene	Rat	Kidney function; NOAEL	8.57E+01	1	1	1	1	1	5	1	2.00E-01	1.71E+01
2-Butanone	Rat	Mortality; LD50	2.19E+02	10	5	1	1	1	5	1	4.00E-03	8.76E-01
2-Methylnaphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	5	1	2.00E-02	8.00E+00
3,3'-Dichlorobenzidine	Mouse	Bile Dt. Hyperplas.; NOAEL	3.70E+00	1	1	1	1	1	5	1	2.00E-01	7.40E-01
4,4'-DDD	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
4,4'-DDE	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
4,4'-DDT	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
4-Methyl-2-pentanone	Rat	Lvr & Kid function; NOAEL	2.50E+02	10	1	1	1	1	5	1	2.00E-02	5.00E+00
Acenaphthene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	5	1	2.00E-02	3.50E+00
Acenaphthylene	Mouse	Hepatotoxicity; NOAEL	1.75E+02	10	1	1	1	1	5	1	2.00E-02	3.50E+00
Acetone	Rat	Lvr & Kid damage; NOAEL	1.00E+02	10	1	1	1	1	5	1	2.00E-02	2.00E+00
Aldrin	Rat	Reprod.; NOAEL	2.00E-01	1	1	1	1	1	5	1	2.00E-01	4.00E-02
Alpha-Chlordane	Mouse	Reprod.; NOAEL	4.58E+00	1	1	1	1	1	5	1	2.00E-01	9.16E-01
Aluminum	Rat	Reprod.; NOAEL	5.00E+01	1	1	1	1	1	5	1	2.00E-01	1.00E+01
Anthracene	Mouse	Hepatotoxicity; NOAEL	1.00E+03	10	1	1	1	1	5	1	2.00E-02	2.00E+01
Antimony	Mouse	Longevity; LOAEL	1.25E+00	1	5	1	5	1	5	1	8.00E-03	1.00E-02
Aroclor-1248	Rhesus Monkey	Reprod.; LOAEL	1.00E-01	1	1	1	5	1	5	1	4.00E-02	4.00E-03
Aroclor-1254	Mouse	Reprod.; LOAEL	1.35E+00	1	1	1	5	1	5	1	4.00E-02	5.40E-02
Aroclor-1260	Mouse	Reprod.; LOAEL	1.35E+00	1	1	1	5	1	5	1	4.00E-02	5.40E-02
Arsenic	Mouse	Reprod.; LOAEL	1.26E+00	1	1	1	5	1	5	1	4.00E-02	5.04E-02
Barium	Rat	Growth; NOAEL	5.06E+00	1	1	1	1	1	5	1	2.00E-01	1.01E+00
Benzene	Mouse	Reprod.; LOAEL	2.64E+02	1	1	1	5	1	5	1	4.00E-02	1.05E+01
Benzo(a)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(a)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(b)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(g,h,i)perylene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzo(k)fluoranthene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Benzoic acid	Rat	Micropathology; NOAEL	8.00E+01	1	1	1	1	1	5	1	2.00E-01	1.60E+01
Beryllium	Rat	Longevity; NOAEL	6.60E-01	1	5	1	1	1	5	1	4.00E-02	2.64E-02

TABLE 3-25
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE SHORT-TAILED SHREW
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Bis(2-ethylhexyl)phthalate	Mouse	Reprod.; NOAEL	1.83E+01	1	1	1	1	1	5	1	2.00E-01	3.66E+00
Boron	Dog	Reprod.; NOAEL	1.75E+01	1	1	1	1	1	5	1	2.00E-01	3.50E+00
Bromodichloromethane	Mouse	Kidney lesion; LOAEL	1.79E+01	1	1	1	5	1	5	1	4.00E-02	7.16E-01
Bromomethane	Rat	Histopathology; NOAEL	1.40E+00	10	1	1	1	1	5	1	2.00E-02	2.80E-02
Butyl benzyl phthalate	Rat	Liver wt.; NOAEL	1.59E+02	10	1	1	1	1	5	1	2.00E-02	3.18E+00
Cadmium	Mouse	Reprod.; LOAEL	2.52E+00	1	1	1	5	1	5	1	4.00E-02	1.01E-01
Carbazole	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Carbon disulfide	Rabbit	Fetal develop.; NOAEL	1.10E+01	1	1	1	1	1	5	1	2.00E-01	2.20E+00
Chlorobenzene	Dog	Liver damage; NOAEL	2.73E+01	10	1	1	1	1	5	1	2.00E-02	5.45E-01
Chloroform	Rat	Lvr & Kid function; NOAEL	1.50E+02	10	1	1	1	1	5	1	2.00E-02	3.00E+00
Chloromethane	Rat	Lvr Histopath.; NOAEL	3.36E+01	10	1	1	1	1	5	1	2.00E-02	6.72E-01
Chromium VI	Mouse	Reprod.; LOAEL	4.60E+00	1	1	1	5	1	5	1	4.00E-02	1.84E-01
Chrysene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Cis-1,3-dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	5	1	2.00E-02	6.00E-02
Cobalt	Rat	Reprod.; NOAEL	5.00E+00	10	1	1	1	1	5	1	2.00E-02	1.00E-01
Copper	Rat	Reprod.; NOAEL	6.60E+01	1	1	1	1	1	5	1	2.00E-01	1.32E+01
Cyanide	Rat	Reprod.; LOAEL	6.87E+01	1	1	1	5	1	5	1	4.00E-02	2.75E+00
Di-n-butylphthalate	Mouse	Reprod.; NOAEL	5.50E+02	1	1	1	1	1	5	1	2.00E-01	1.10E+02
Dibenzo(a,h)anthracene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Dibenzofuran	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Dieldrin	Rat	Reprod.; LOAEL	2.00E-01	1	1	1	5	1	5	1	4.00E-02	8.00E-03
Diethyl phthalate	Mouse	Reprod.; NOAEL	4.58E+03	1	1	1	1	1	5	1	2.00E-01	9.17E+02
Endosulfan II	Rat	Reprod.; NOAEL	1.50E+00	10	1	1	1	1	5	1	2.00E-02	3.00E-02
Endosulfan sulfate	Rat	Reprod.; NOAEL	1.50E+00	10	1	1	1	1	5	1	2.00E-02	3.00E-02
Endrin	Mouse	Reprod.; LOAEL	9.20E-01	1	1	1	5	1	5	1	4.00E-02	3.68E-02
Endrin aldehyde	Mouse	Reprod.; LOAEL	9.20E-01	1	1	1	5	1	5	1	4.00E-02	3.68E-02
Endrin ketone	Mouse	Reprod.; LOAEL	9.20E-01	1	1	1	5	1	5	1	4.00E-02	3.68E-02
Ethylbenzene	Rat	Lvr & Kid function; LOAEL	4.08E+02	10	1	1	5	1	5	1	4.00E-03	1.63E+00
Fluoranthene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	5	1	2.00E-02	2.50E+00
Fluorene	Mouse	Red Bld Cell Ct.; NOAEL	1.25E+02	10	1	1	1	1	5	1	2.00E-02	2.50E+00
Gamma-Chlordane	Mouse	Reprod.; NOAEL	4.58E+00	1	1	1	1	1	5	1	2.00E-01	9.16E-01
Heptachlor	Rat	Reprod.; NOAEL	8.00E-01	1	1	1	1	1	5	1	2.00E-01	1.60E-01
Heptachlor epoxide	Dog	Liver wt.; LEL	2.96E-04	10	1	1	5	1	5	1	4.00E-03	1.18E-06
Indeno(1,2,3-d)pyrene	Mouse	Reprod.; LOAEL	1.00E+01	1	1	1	5	1	5	1	4.00E-02	4.00E-01
Lead	Rat	Reprod.; NOAEL	8.00E+00	1	1	1	1	1	5	1	2.00E-01	1.60E+00

TABLE 3-25
DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE SHORT-TAILED SHREW
NSB-NLON, GROTON, CONNECTICUT

Chemical	Test Species	Endpoint	Laboratory Test Result (mg/kg/day)	a	b	c	d	e	f	g	Final Uncertainty Factor ⁽¹⁾	Derived NOAEL ⁽²⁾ (mg/kg/day)
Manganese	Rat	Reprod.; NOAEL	8.80E+01	1	1	1	1	1	5	1	2.00E-01	1.76E+01
Mercury	Mouse	Reprod.; NOAEL	1.32E+01	1	1	1	1	1	5	1	2.00E-01	2.64E+00
Methoxychlor	Rat	Reprod.; NOAEL	4.00E+00	1	1	1	1	1	5	1	2.00E-01	8.00E-01
Methylene chloride	Rat	Liver histology; NOAEL	5.85E+00	1	1	1	1	1	5	1	2.00E-01	1.17E+00
Naphthalene	Rat	Reprod.; NOAEL	4.00E+02	10	1	1	1	1	5	1	2.00E-02	8.00E+00
Nickel	Rat	Reprod.; NOAEL	4.00E+01	1	1	1	1	1	5	1	2.00E-01	8.00E+00
OCDD	Rat	Reprod.; NOAEL	1.00E-06	1	1	1	1	1	5	1	2.00E-01	2.00E-07
Phenanthrene	Mouse	Mortality; LD50	1.28E+02	10	5	1	5	1	5	1	8.00E-04	1.03E-01
Pyrene	Mouse	Kidney Lesions; NOAEL	7.50E+01	10	1	1	1	1	5	1	2.00E-02	1.50E+00
Selenium	Mouse	Reprod.; LOAEL	7.50E-01	1	1	1	5	1	5	1	4.00E-02	3.00E-02
Silver	Rat	Histopathology; NOAEL	1.40E+02	1	1	1	1	1	5	1	2.00E-01	2.80E+01
Styrene	Dog	Liver wt.; NOAEL	2.00E+02	10	1	1	1	1	5	1	2.00E-02	4.00E+00
Tetrachloroethene	Mouse	Hepatotoxicity; NOAEL	1.40E+01	10	1	1	1	1	5	1	2.00E-02	2.80E-01
Thallium	Rat	Reprod.; LOAEL	7.40E-01	10	1	1	5	1	5	1	4.00E-03	2.98E-03
Toluene	Mouse	Reprod.; LOAEL	2.60E+02	1	1	1	5	1	5	1	4.00E-02	1.04E+01
Trans-1,3-Dichloropropene	Rat	Kidney wt.; NOAEL	3.00E+00	10	1	1	1	1	5	1	2.00E-02	6.00E-02
Trichloroethene	Mouse	Hepatotoxicity; LOAEL	7.00E+01	10	1	1	5	1	5	1	4.00E-03	2.80E-01
Vanadium	Rat	Reprod.; LOAEL	2.10E+00	1	1	1	5	1	5	1	4.00E-02	8.40E-02
Vinyl acetate	Rat	Reprod.; NOAEL	4.77E+02	1	1	1	1	1	5	1	2.00E-01	9.54E+01
Xylenes, total	Mouse	Reprod.; NOAEL	2.06E+00	1	1	1	1	1	5	1	2.00E-01	4.12E-01
Zinc	Rat	Reprod.; NOAEL	1.60E+02	1	1	1	1	1	5	1	2.00E-01	3.20E+01
2,4-Dimethylphenol	Mouse	Hemat.Changes; NOAEL	5.00E+01	10	1	1	1	1	5	1	2.00E-02	1.00E+00
4-Methylphenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	5	1	2.00E-01	1.20E+01
Beta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	5	1	2.00E-02	8.00E-02
Delta-BHC	Rat	Organ Histology; NOAEL	4.00E+00	10	1	1	1	1	5	1	2.00E-02	8.00E-02
Endosulfan I	Rat	Reprod.; NOAEL	1.50E+00	10	1	1	1	1	5	1	2.00E-02	3.00E-02
Gamma-BHC	Rat	Reproduction; NOAEL	8.00E+00	1	1	1	1	1	5	1	2.00E-01	1.60E+00
Pentachlorophenol	Rat	Liver/Kid. Path.; NOAEL	3.00E+00	1	1	1	1	1	5	1	2.00E-01	6.00E-01
2-Nitroaniline	Rat	Spl.Caps. Lesions; LOAEL	1.25E+01	1	1	1	1	1	5	1	2.00E-01	2.50E+00
4,6 - Dinitro-2-methylphenol	Rat	Reproduction; NOAEL	1.00E+01	10	1	1	1	1	5	1	2.00E-02	2.00E-01
4-Chloro-3-methyl phenol	Mink	Reproduction; NOAEL	2.16E+02	1	1	1	1	1	5	1	2.00E-01	4.32E+01
Di-n-octyl phthalate	Mouse	Reproduction; NOAEL	5.50E+02	1	1	1	1	1	5	1	2.00E-01	1.10E+02
Phenol	Rat	Fetal Body Wt.; NOAEL	6.00E+01	1	1	1	1	1	5	1	2.00E-01	1.20E+01
OCDD	Rat	Blood Chem.; NOAEL	4.80E-01	10	1	1	1	1	5	1	2.00E-02	9.60E-03
1,2,3,4,6,7 - HCDD	Rat	Reproduction; NOAEL	1.00E-06	1	1	1	1	1	5	1	2.00E-01	2.00E-07

TABLE 3-25

**DERIVATION OF NO-OBSERVED-APPARENT-EFFECTS-LEVELS FOR THE SHORT-TAILED SHREW
NSB-NLON, GROTON, CONNECTICUT**

- 1 Final Uncertainty Factor = $(1/UF_a * 1/UF_b * 1/UF_c * 1/UF_d * 1/UF_e * 1/UF_f)$
2 Derived Wildlife NOAEL = Laboratory Test Endpoint * Uncertainty Factor
 UF_a = Subchronic Exposure Period
 UF_b = Nonsensitive Endpoint
 UF_c = Acute to Chronic LOAEL
 UF_d = LOAEL to NOAEL
 UF_e = Within Taxonomic Order
 UF_f = Mammal to Bird

TABLE 3-26
BACKGROUND CONCENTRATIONS - SEDIMENT⁽¹⁾
THAMES RIVER
NSB-NLON, GROTON, CONNECTICUT

Analyte	Background Concentration (mg/kg)
Aluminum	54,500
Antimony	0.405
Arsenic	6.75
Barium	NA ⁽²⁾
Beryllium	NA
Boron	NA
Cadmium	0.39
Calcium	NA
Chromium	73
Cobalt	NA
Copper	36.8 mg/kg
Iron	29,250
Lead	42.15
Magnesium	NA
Manganese	486
Mercury	0.169
Nickel	34.5
Potassium	NA
Selenium	0.32
Silver	0.615
Sodium	NA
Thallium	NA
Vanadium	NA
Zinc	112.45

- 1 Background concentrations established using NOAA Technical Memorandum NOS ORCA 80, "Biological Effects of Toxic Contaminants in Sediments from Long Island Sound and Environs" (NOAA, 1994).
- 2 NA - Not Available.

TABLE 3-27

**SUMMARY OF RECEPTOR INFORMATION
NSB-NLON, GROTON, CONNECTICUT**

Receptor	Guild	Parameter	Value	Reference
Short-tailed Shrew	Insectivore	Body Weight	15 grams	Schlesinger & Potter (1974)
		Skin Surface	54 cm ²	Pearson (1947)
		Water Ingestion	0.223 g/g-day	Chew (1951)
		Food Ingestion	7.95 g/day	Barrett & Stuek (1976)
		Soil Ingestion	20 % diet	estimated
		Inhalation Rate	0.026	EPA (1993a) estimated
		Diet Composition	69% Animal	Whitaker and Ferraro (1963)
		Home Range	0.1 - 0.22 ha	Platt (1976)

Receptor	Guild	Parameter	Value	Reference
Raccoon	Omnivore	Body Weight	3.67 kg (adult female)	Johnson (1970)
		Skin Surface	3,414 cm ² (adult female)	EPA (1993a) estimate
		Water Ingestion	0.083 g/g-day (adult female)	EPA (1993a) estimate
		Food Ingestion	135.6 g/day (adult female)	estimated using EPA (1993)
		Soil Ingestion	13%	Beyer et al. (1994)
		Inhalation Rate	2.17 m ³ /day (adult female)	EPA (1993a) estimated
		Diet Composition	37.3 % Animal	Hamilton (1951)
		Home Range	39 ha (adult female)	Lotze (1979)

TABLE 3-27 (Continued)
SUMMARY OF RECEPTOR INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Receptor	Guild	Parameter	Value	Reference
Red-tailed Hawk	Carnivore	Body Weight	1030 grams (adult male)	Craighead and Craighead (1956)
		Skin Surface	1021 cm ²	estimated from Walsberg and
		Water Ingestion	0.058 g/g-day	Estimated from Braun and Calder
		Food Ingestion	103 g/day	Craighead and Craighead (1956)
		Soil Ingestion	2% of diet	lowest value for avian species
		Inhalation Rate	0.42 m ³ /day	estimated from Lasiewski and
		Diet Composition	98% Animal	Adamcik et al. (1979)
		Home Range	60 - 160 ha	Fitch et al. (1946)

Receptor	Guild	Parameter	Value	Reference
Herring Gull	Omnivore	Body Weight	951 grams (adult female)	Norstrom et al. (1986)
		Skin Surface	1,001 cm ² (adult female)	EPA (1993) estimate
		Water Ingestion	0.059 g/g-day (adult female)	EPA (1993) estimate
		Food Ingestion	0.21 g/g-day (adult female)	Pierotti & Annett (1991)
		Soil Ingestion	13% of diet	(EPA, 1993a)
		Inhalation Rate	0.41 m ³ /day (adult female)	EPA (1993a) estimate
		Diet Composition	74% Animal	Haycock and Threlfall (1975)
		Home Range	5 - 10 ha (adult female)	Pierotti, pers. comm. as cited in

TABLE 3-27 (Continued)
SUMMARY OF RECEPTOR INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Receptor	Guild	Parameter	Value	Reference
Mallard Duck	Omnivore	Body Weight	1,043 grams (adult female)	Nelson & Martin (1953)
		Skin Surface	1,030 cm ² (adult female)	EPA (1993a) estimated
		Water Ingestion	0.058 g/g-day (adult female)	EPA (1993a) estimated
		Food Ingestion	59.8 g/day (adult female)	estimated from EPA (1993)
		Soil Ingestion	< 2 %	Beyer et al. 1994
		Inhalation Rate	0.42 m ³ /day (adult female)	EPA (1993a) estimated
		Diet Composition	66.5% Animal	Swanson et al. (1985)
		Home Range	540 ha (adult females)	Kirby et al. (1985)
Receptor	Guild	Parameter	Value	Reference
Cormorant (Double-Crested)	Piscivore	Body Weight	2,100 grams	Croxall, ed. (1987)
		Skin Surface	1,644 cm ²	estimated from EPA (1993a)
		Water Ingestion	0.103 g/g-day	estimated from EPA (1993a)
		Food Ingestion	94.3 g/day	estimated from EPA (1993a)
		Soil Ingestion	< 2 %	estimated from EPA (1993a)
		Inhalation Rate	0.724 m ³ /day	estimated from EPA (1993a)
		Diet Composition	98% Animal	Croxall, ed. (1987)
		Home Range	8-16 km	Palmer (1962)

TABLE 3-27 (Continued)
SUMMARY OF RECEPTOR INFORMATION
NSB-NLON, GROTON, CONNECTICUT

Receptor	Guild	Parameter	Value	Reference
Barred Owl	Carnivore	Body Weight	630 grams (adult male)	Terres (1991)
		Skin Surface	736 cm ² (adult male)	estimated from EPA (1993a)
		Water Ingestion	0.069 g/g-day (adult male)	estimated from EPA (1993a)
		Food Ingestion	43 g/day	estimated from EPA (1993a)
		Soil Ingestion	<2% of diet	lowest value for avian species
		Inhalation Rate	0.377 m ³ /day	estimated from EPA (1993a)
		Diet Composition	98% Animal	Terres (1991)
		Home Range	86.1 - 369.0 ha	Nicholls and Warner (1972)

TABLE 3-28

BIOACCUMULATION FACTORS AND SOURCES
NSB-NLON, GROTON, CONNECTICUT

Soil Contaminant	BAF	Source ⁽¹⁾	Soil Contaminant	BAF	Source ⁽¹⁾
1,1,2,2-Tetrachloroethane	*	1	Chrysene	*	1
1,1,2-Trichloroethane	*	1	Cis-1,3-dichloropropene	*	1
1,1-Dichloroethene	*	1	Cobalt	1.00E+00	2
1,2-Dichloroethene (total)	*	1	Copper	9.30E-01	3
1,4-Dichlorobenzene	*	1	Cyanide	1.00E+00	2
2-Butanone	*	1	Di-n-butylphthalate	*	1
2-Methylnaphthalene	*	1	Dibenzo(a,h)anthracene	*	1
3,3'-Dichlorobenzidine	*	1	Dibenzofuran	*	1
4,4'-DDD	*	1	Dieldrin	*	1
4,4'-DDE	*	1	Diethyl phthalate	*	1
4,4'-DDT	*	1	Endosulfan ii	*	1
4-Methyl-2-pentanone	*	1	Endosulfan sulfate	*	1
Acenaphthene	*	1	Endrin	*	1
Acenaphthylene	*	1	Endrin aldehyde	*	1
Acetone	*	1	Endrin ketone	*	1
Aldrin	*	1	Ethylbenzene	*	1
Alpha-Chlordane	*	1	Fluoranthene	*	1
Aluminum	1.00E+00	2	Fluorene	*	1
Anthracene	*	1	Gamma-Chlordane	*	1
Antimony	1.00E+00	2	Heptachlor	*	1
Aroclor-1248	*	1	Heptachlor epoxide	*	1
Aroclor-1254	*	1	Indeno(1,2,3-Cd)pyrene	*	1
Aroclor-1260	*	1	Iron	1.00E+00	2
Arsenic	1.00E+00	2	Lead	1.24E+00	4
Barium	1.00E+00	2	Manganese	1.00E+00	2
Benzene	*	1	Mercury	1.00E+00	2

TABLE 3-28
BIOACCUMULATION FACTORS AND SOURCES
NSB-NLON, GROTON, CONNECTICUT

Soil Contaminant	BAF	Source ⁽¹⁾	Soil Contaminant	BAF	Source ⁽¹⁾
Benzo(a)anthracene	*	1	Methoxychlor	*	1
Benzo(a)pyrene	*	1	Methylene chloride	*	1
Benzo(b)fluoranthene	*	1	Naphthalene	*	1
Benzo(g,h,i)perylene	*	1	Nickel	1.00E+00	2
Benzo(k)fluoranthene	*	1	OCDD	*	1
Benzoic acid	*	1	Phenanthrene	*	1
Beryllium	1.00E+00	2	Pyrene	*	1
Bis(2-ethylhexyl)phthalate	*	1	Selenium	1.00E+00	2
Boron	1.00E+00	2	Silver	1.00E+00	2
Bromodichloromethane	*	1	Styrene	*	1
Bromomethane	*	1	Tetrachloroethene	*	1
Butyl benzyl phthalate	*	1	Thallium	1.00E+00	2
Cadmium	2.00E+00	3	Toluene	*	1
Carbazole	*	1	Trans-1,3-dichloropropene	*	1
Carbon disulfide	*	1	Trichloroethene	*	1
Chlorobenzene	*	1	Vanadium	1.00E+00	2
Chloroform	*	1	Vinyl acetate	*	1
Chloromethane	*	1	Xylenes, total	*	1
Chromium	1.00E+00	2	Zinc	2.30E+00	3

Notes 1) Source:

- 1 BAFs calculated using the following formula and a site-specific TOC: $BAF = YL / (0.66)(foc)$
- 2 No literature value identified; assigned a value of 1.0
- 3 Beyer, W.N. and E.J. Cromartie. 1987. A Survey of Pb, Cu, Zn, Cd, Cr, As, and Se in Earthworms and Soil from Diverse Sites. Env. Monitoring and Assessment. 8:27-36.
- 4 Gish, C.D. and R.E. Christensen. 1973. Cadmium, Nickel, Lead and Zinc in Earthworms from Roadside Soil. Envir. Sci. Technol. 7(11): 1060-1062.

TABLE 3-29

EXPOSURE PARAMETERS USED TO ASSESS CHEMICALS PRESENT IN FOOD
NSB-NLON, GROTON, CONNECTICUT

Abbreviation	Description	Value Used	Impact on Risk Estimate
PC _{prey}	Predicted concentration in prey	Worst-case	Overestimate
F	Food consumed	Shrew = 7.95g Raccoon = 1135.6g Hawk = 103g Gull = 0.21g M. Duck = 59.8g Cormorant = 94.3g B. Owl = 43g	Neutral Neutral Neutral Neutral Neutral Neutral Neutral
FI	Fractional intake	100%	Overestimate
AF	Absorption fraction	100%	Overestimate
WR	Weight of receptor (kg)	Winter weights	Overestimate

TABLE 3-30

EXPOSURE PARAMETERS USED TO ASSESS INCIDENTAL INGESTION OF SOIL
NSB-NLON, GROTON, CONNECTICUT

Abbreviation	Description	Value Used	Impact on Risk Estimate
PC _{soil}	Predicted concentration in soil	Worst-case	Overestimate
F	Food consumed	Shrew = 7.95 g Raccoon = 1135.6g Hawk = 103g Gull = 0.21g M. Duck = 59.8g Cormorant = 94.3g B. Owl = 43g	Neutral Neutral Neutral Neutral Neutral Neutral Neutral
FA	Soil as % of diet	Shrew = 20% Raccoon = 13% Hawk = 2% Gull = 13% M. Duck = < 2% Cormorant = < 2% B. Owl = < 2%	Overestimate Neutral Neutral Neutral Neutral Neutral Neutral
FI	Fractional intake	100%	Overestimate
AF	Absorption fraction	100%	Overestimate
WR	Weight of receptor (kg)	Winter weights	Overestimate

TABLE 3-31

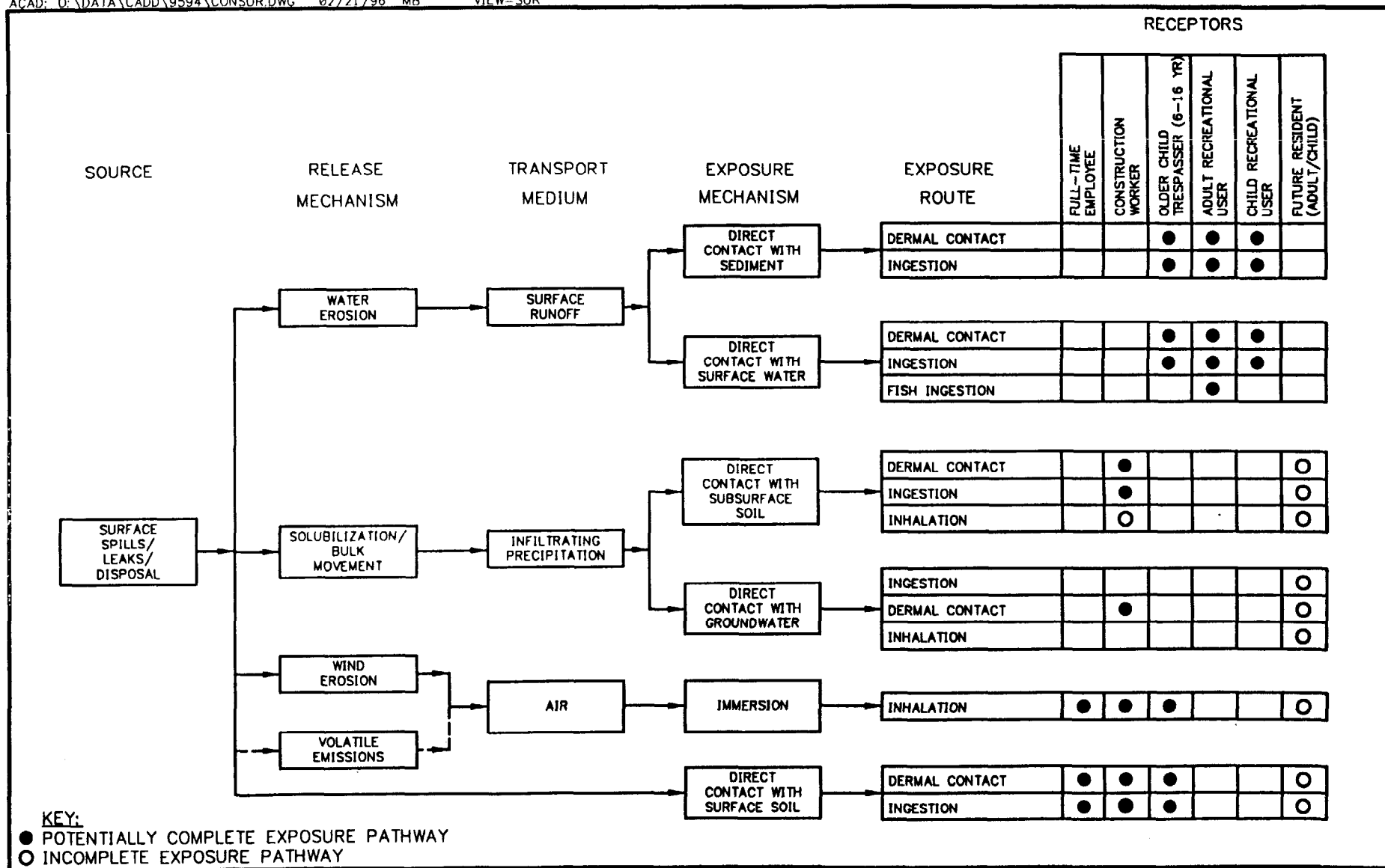
EXPOSURE PARAMETERS USED TO ASSESS INGESTION OF SURFACE WATER
NSB-NLON, GROTON, CONNECTICUT

Abbreviation	Description	Value Used	Impact on Risk Estimate
PC _{surface water}	Concentration in surface water	Worst-case	Overestimate
F	Water consumed	Shrew = 0.233g Raccoon = 0.083g Hawk = 0.058g Gull = 0.059g M. Duck = 0.058g Cormorant = 0.103g B. Owl = 0.069g	Neutral Neutral Neutral Neutral Neutral Neutral Neutral
FI	Fractional intake	100%	Overestimate
AF	Absorption fraction	100%	Overestimate
WR	Weight of receptor (kg)	Winter weights	Overestimate

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CONCEPTUAL SITE MODEL – SURFACE SOURCES
NSB-NLON
GROTON, CONNECTICUT

FIGURE 3-1



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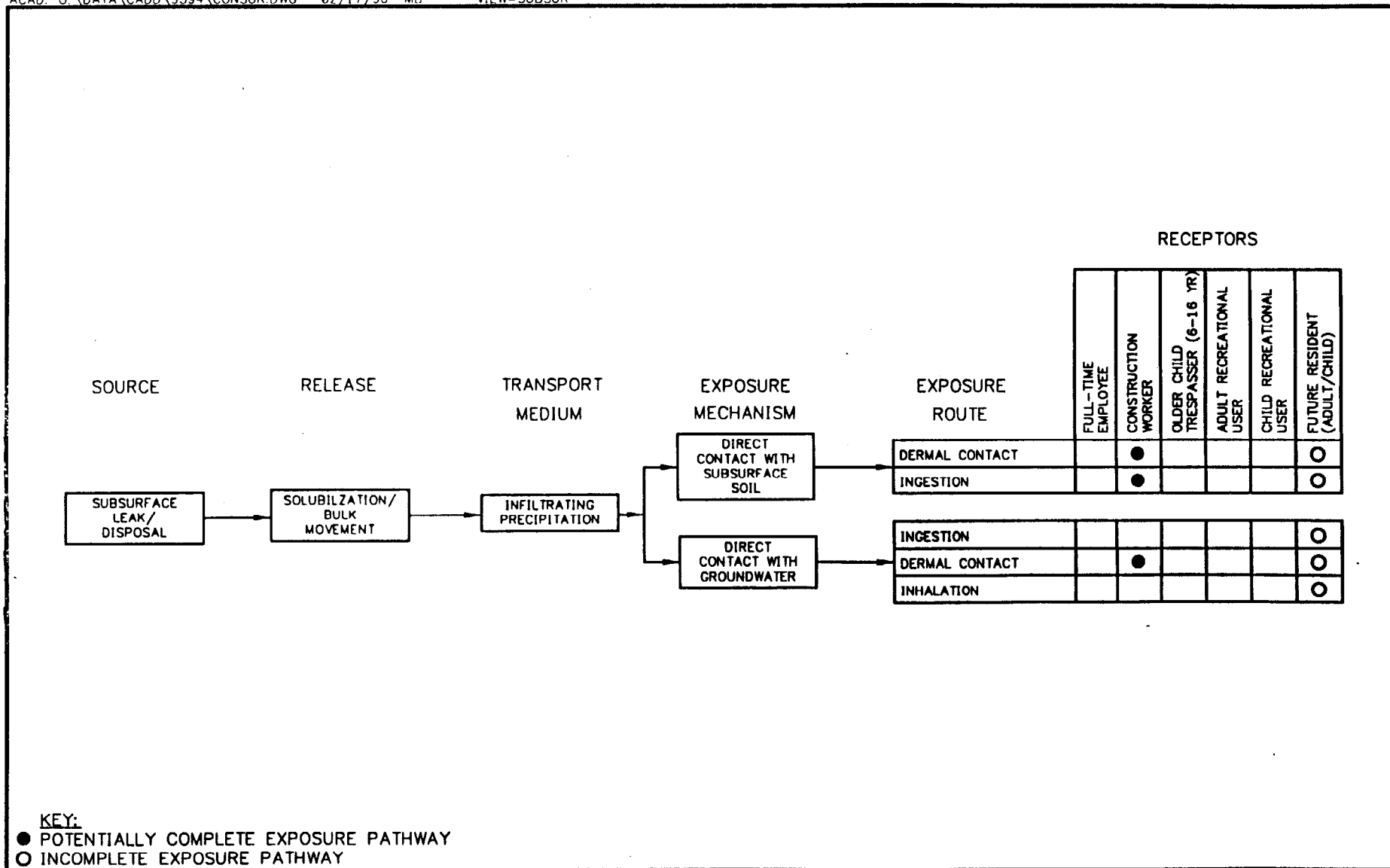
Revision 1
 March 1997

CTO 128

D-01-95-10

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CTO 129



CONCEPTUAL SITE MODEL - SUBSURFACE SOURCES

NSB-NLON
 GROTON, CONNECTICUT

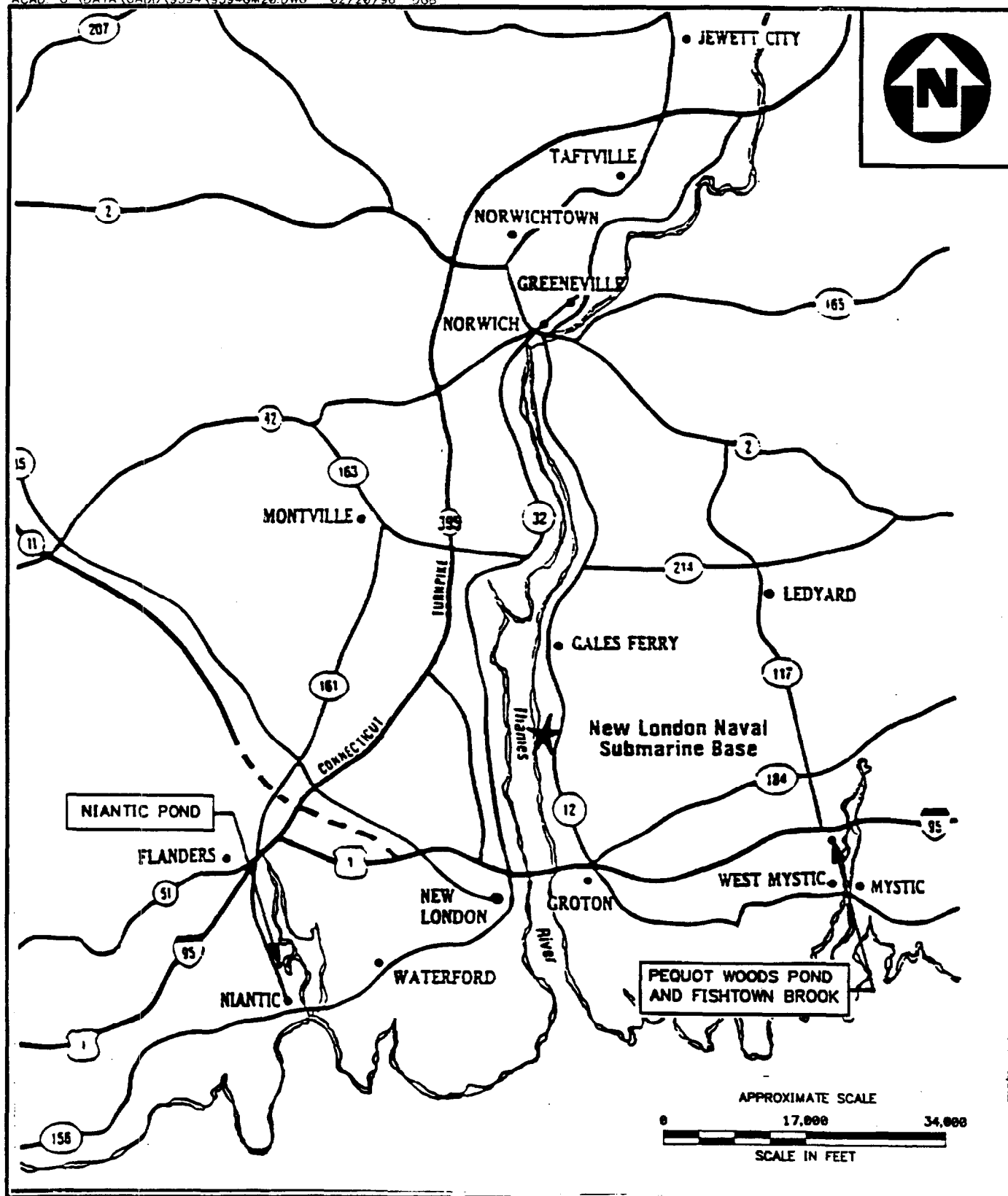
FIGURE 3-2



Brown & Root Environmental

Revision 1
 March 1997

ACAD: 0:\DATA\CADD\9594\9594GM20.DWG 02/20/96 DGB

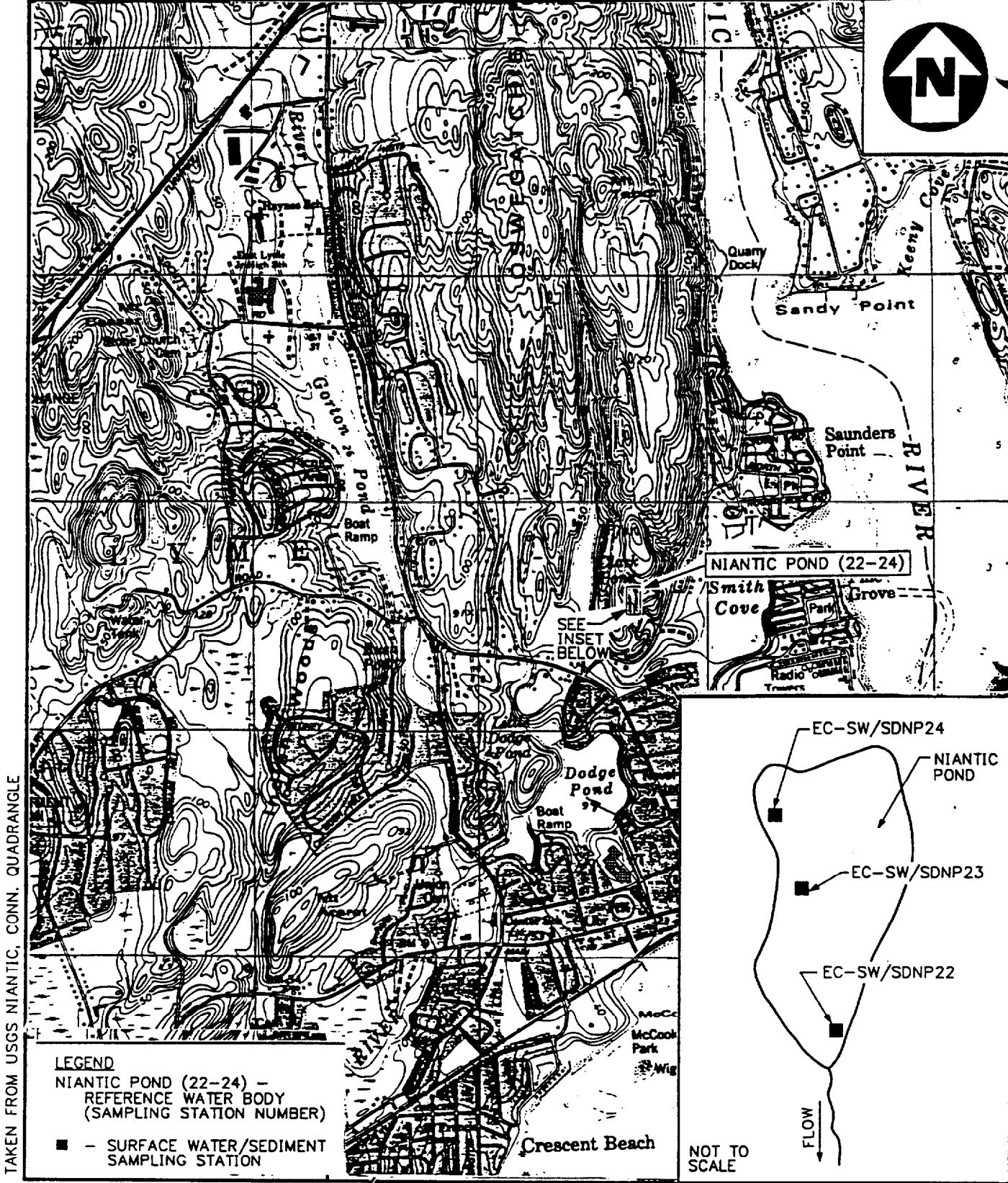


REFERENCE PONDS (PEQUOT WOODS AND
NIANTIC POND) AND REFERENCE STREAM
(FISHTOWN BROOK) LOCATION MAP
NSB-NLON, GROTON, CONNECTICUT

FIGURE 3-3


Brown & Root Environmental

ACAD: O:\DATA\CADD\9594\9594CW18.DWG 02/18/96 DGB



SAMPLING LOCATIONS

NIANTIC POND

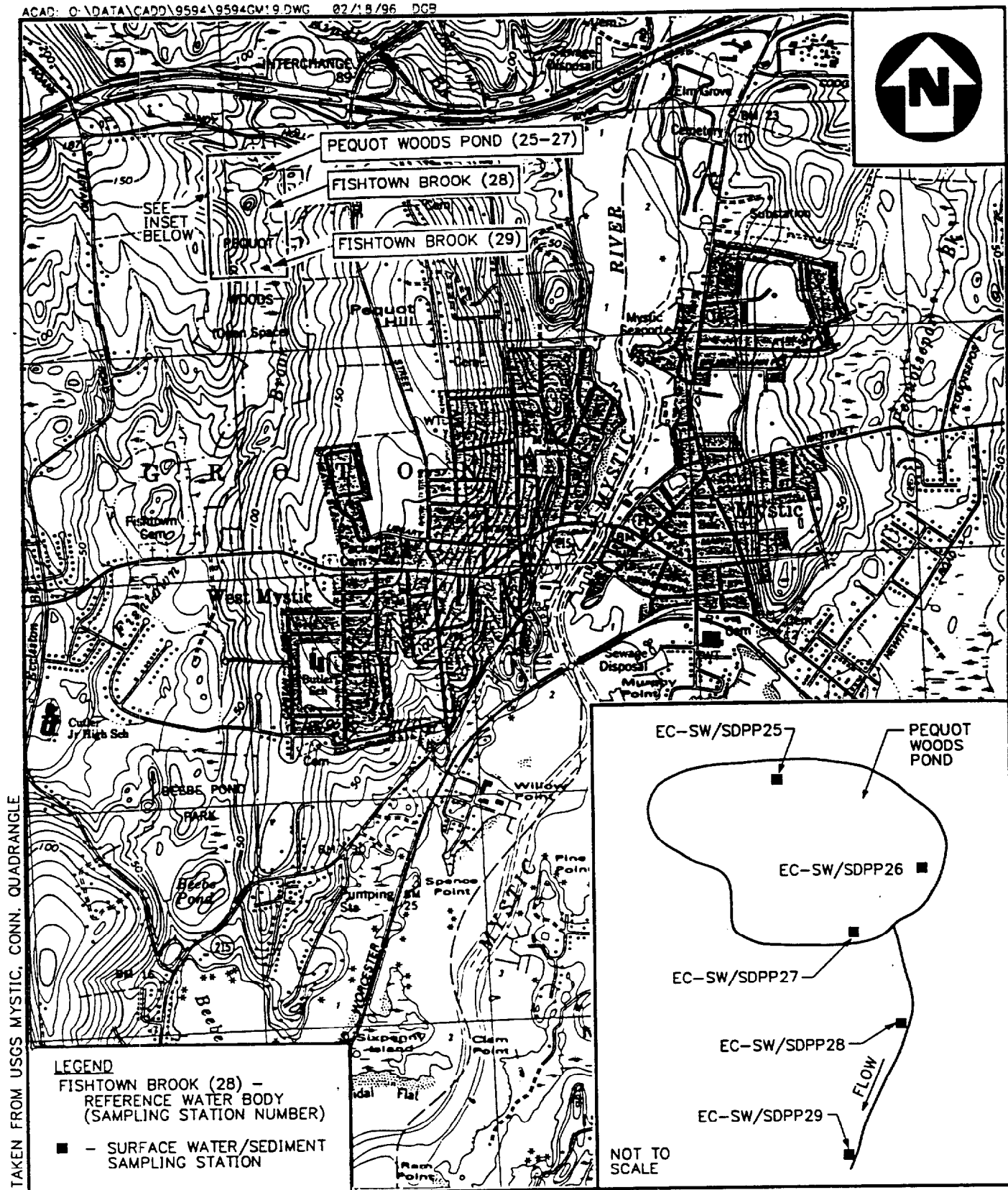
NSB-NLON, GROTON, CONNECTICUT

FIGURE 3-4



Brown & Root Environmental

ACAD: 0:\DATA\CADD\9594\9594GM19.DWG 02/18/96 DGB



**SAMPLING LOCATIONS
PEQUOT WOODS POND
AND FISHTOWN BROOK**

NSB-NLON, GROTON, CONNECTICUT

0 2000 4000

SCALE IN FEET

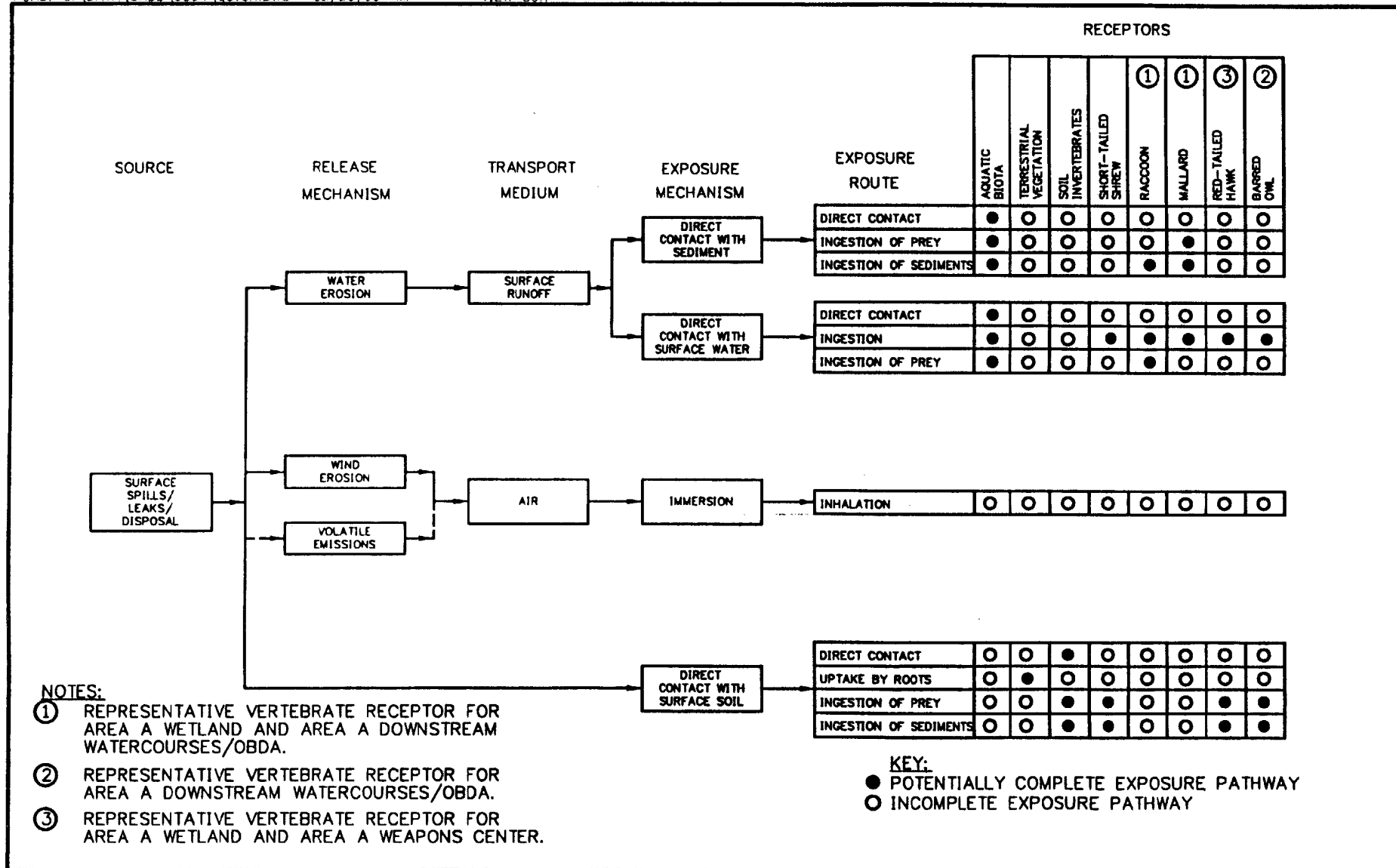
FIGURE 3-5



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D-01-95-10

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**CONCEPTUAL SITE MODEL – AREA A WETLAND,
AREA A DOWNSTREAM WATERCOURSES/OBDA
NSB-NLON
GROTON, CONNECTICUT**

FIGURE 3-6



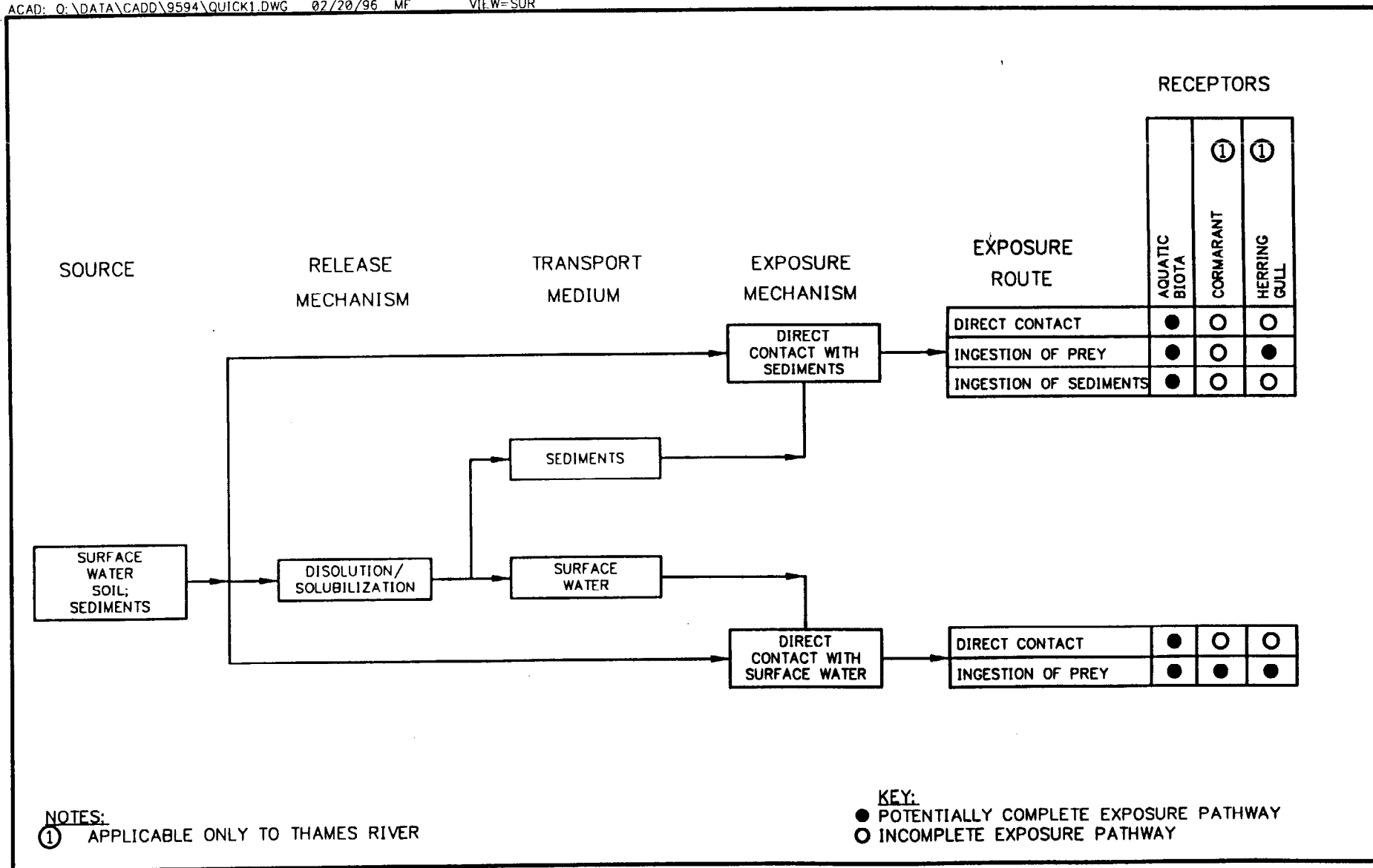
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CONCEPTUAL SITE MODEL
THAMES RIVER AND GOSS COVE
NSB-NLON
GROTON, CONNECTICUT

FIGURE 3-7



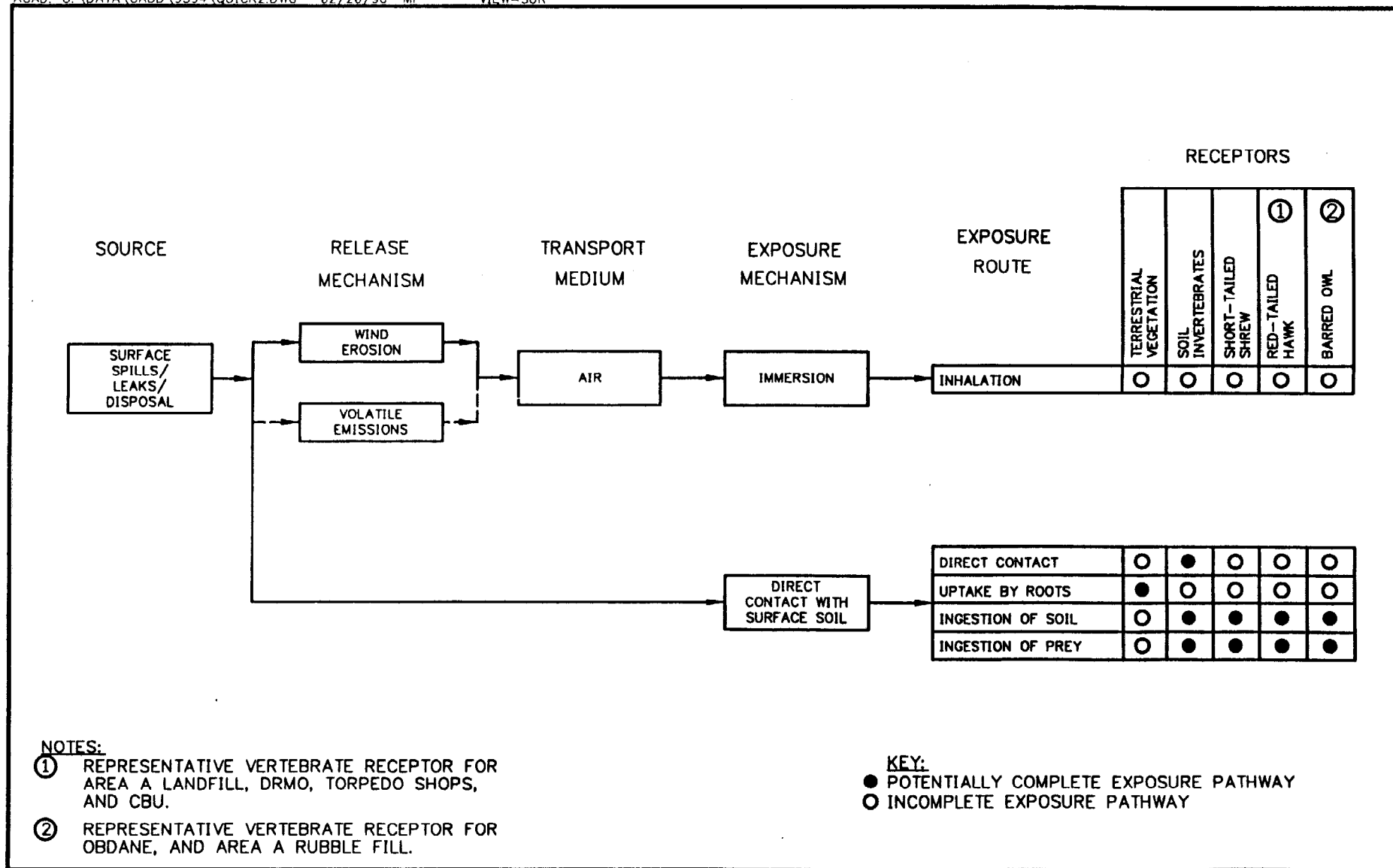
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**CONCEPTUAL SITE MODEL - AREA A LANDFILL,
DRMO, TORPEDO SHOPS, CBU, OBDANE, AREA A RUBBLEFILL
NSB-NLON
GROTON, CONNECTICUT**

FIGURE 3-8



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4.0 GENERAL PHYSICAL CHARACTERISTICS OF NSB-NLON

This section provides a summary of the general physical characteristics of NSB-NLON including topography and surface features, climate and meteorology, surface water quality and hydrology, soil characteristics, geology, hydrogeology, etc. This section has been designed to discuss "macroscopic" aspects of the facility in general, rather than site-specific physical features. Site-specific physical features are discussed in Sections 5.0 through 17.0.

4.1 TOPOGRAPHY AND SURFACE FEATURES

The topography of NSB-NLON is depicted on Drawing 2 (Volume III). The topographic contours were provided by NSB-NLON. Four bedrock highs form the topographic upland areas at the NSB-NLON and in the surrounding area. To the east of the facility, Baldwin Hill reaches an elevation of 245 feet above mean sea level (msl). In the northern, central, and southern portions of the facility, the bedrock highs reach elevations that also exceed 200 feet above msl. These bedrock highs have a northwest-southeast trend, which is consistent with the regional strike and other bedrock features in the region (USGS, 1967). The western edge of the facility borders the Thames River.

At NSB-NLON, the bedrock highs slope downward to two small, west-trending valleys. Bedrock outcrops are prevalent along steep topographic slopes. In addition to the large bedrock highs there are several small sub-ridges, which are visible as bedrock outcrops at the facility. Two primary sub-ridges include one east of the DRMO and one northeast of the Goss Cove Landfill. A conceptual north/south cross-section of the bedrock highs and valleys (A-A') is provided on Drawing 3 (Volume III).

The two valleys between the bedrock highs are characterized as wetlands and poorly-drained stream valleys. The valleys slope gently to the Thames River. In the northern valley, the ground elevation ranges from approximately 80 feet in the eastern portion to near sea-level along the Thames River. The eastern (upper) portion of this valley contains the Area A Wetland, which drains through an earthen dike into the Area A Downstream Watercourses. The ground surface drops steeply across the dike to thirty to forty feet below the elevation of the wetland. Historically, the ground surface decreased more uniformly toward the Thames River (USGS, 1960). A conceptual east/west cross-section of the northern valley (B-B') is provided on Drawing 3 (Volume III). The steep drop in the ground elevation was caused by construction of the dike and subsequent filling of the wetlands area with dredge spoils from the Thames River.

In the southern valley, the ground elevation slopes mildly from approximately 50 feet in the eastern portion to near sea-level along the Thames River. Historically, there was a topographic depression at the former Crystal Lake between Tang and Crystal Lake Road. The topographic depression has been filled. Filling has also occurred along the Thames River, and the historical shoreline has been extended.

Currently NSB-NLON consists of over 300 buildings on 547 acres of land (Atlantic, August 1992). The density of buildings is high along the central bedrock high, in the southern valley, and along the Thames River. In the northern valley, there are streams, a wetland, and a golf course. The northern bedrock high is not highly developed, except along the southern face at the Area A Weapons Center and the Torpedo Shops. The top and northern faces of the northern ridge are wooded, undeveloped areas.

4.2 CLIMATE AND METEOROLOGY

Southeastern Connecticut is in the northern temperate zone. The climate is influenced by cold and dry continental-polar air during the winter and warm, humid maritime air during the summer. During the winter, this region is located near the Polar Front boundary, which separates regions of cold, dry continental-polar air and warm, moist tropical air. The area experiences extensive winter storm activity and variable daily temperatures. During the summer, the Polar Front boundary is located further north, and the region experiences warm weather.

The prevailing winds are southwesterly from the continent and bring most of the weather into the region. Land-sea breezes are also present in the region. Occasional storms moving northward along the mid-Atlantic coast provide strong northeasterly winds and storms, commonly known as "coastals" or "northeasters." Storms are extensive with heavy rainfall and are occasionally of hurricane intensity. Dense fog is frequently advected onshore from the Atlantic Ocean from the spring through the fall (NOAA, 1987).

The average annual temperature at New London, Connecticut, is approximately 50°F. Average monthly temperatures vary from 58-72°F in July and August to 23-30°F in January and February. The average wind speed is approximately 10 miles per hour. Precipitation ranges from 32 to 65 inches of water per year and averages approximately 44 inches per year as measured at New London over an 81-year period. The greatest amount of precipitation occurs in the months of March and August and the least in June and September. Evaporation averages approximately 23 inches per year (NSB-NLON Master Plan, 1988).

4.3 SURFACE WATER HYDROLOGY AND QUALITY

This section summarizes available information regarding surface water hydrology and surface water quality in the vicinity of NSB-NLON. The primary focus of this section is the Thames River, which is the major receiving surface water body proximate to the facility.

4.3.1 Surface Water Hydrology

NSB-NLON is located on the east bank of the Thames River within the Thames River Watershed. The Thames River and its tributaries drain approximately 1,500 square miles of eastern Connecticut, western Rhode Island, and south central Massachusetts. The Thames River originates in the City of Norwich Harbor, at the confluence of the Shetucket and Yantic Rivers, and discharges into Long Island Sound approximately six miles south of NSB-NLON. The Thames River estuary extends north from Long Island Sound to Norwich (16 miles). Widths of the river vary from 1.5 miles at New London Harbor to approximately 500 feet at Norwich Harbor. A dredged channel runs north to south in the river. Depths in the dredged channel are approximately 40 feet below mean sea level between Long Island Sound and the Subase and about 25 feet farther upstream. At NSB-NLON, the width of the channel is approximately 600 to 900 feet. However, the channel is narrower upstream and downstream of NSB-NLON. Outside of the channel, depths are relatively shallow (2 to 10 feet). Upstream of NSB-NLON there are shallow coves that empty into the river. Most of the coves are at least partially cut off from the river by a rail bed.

The two rivers that join to form the Thames River are the Shetucket and Yantic Rivers. The Yantic River has a drainage basin of 88 square miles. Average, minimum, and maximum flows in the Yantic have been reported at 170, 3.5, and 13,400 cubic feet per second (ft^3/s), respectively. The Shetucket, which has a 1,390-square-mile drainage basin, has reported average, minimum, and maximum flows of 2,000, 14, and 52,300 ft^3/s , respectively. According to an engineering study (LMS Engineers, 1992), other sources of inflow to the Thames River are minor in comparison to these flows and to the volume of tidal exchange. Other sources of inflow include wastewater treatment facilities in Norwich, Montville, New London, the City of Groton, and the Town of Groton, as well as combined sewer overflows in Norwich, industrial discharges, and several small streams.

The Thames River is a salt wedge estuary that is highly stratified with fresher water on the surface and denser saline water on the bottom. The river is tidally influenced with a mean tidal range at the New London State Pier of 2.6 feet (LMS Engineers, 1992). A freshwater flushing time of 0.5 to 2 days from Norwich to Long Island Sound has been estimated (Welsh and Stewart, 1984). In comparison, a bottom water flushing

time of greater than 19 days was estimated. The average freshwater flow discharging to Long Island Sound from the Thames River has been estimated as 222 million cubic feet per day (Soderberg and Bruno, 1971). However, streamflow in the Thames River is small in comparison to intertidal volume and exchange (Bohlen and Tramontano, 1977). Very little vertical mixing occurs in the Thames River. The north-south alignment, steep banks, and narrow channel do not permit much wind induced mixing. Therefore, the freshwater outflows reach Long Island Sound in a well defined surface layer.

As previously discussed, the Thames River estuary is stratified with relatively fresh water on the surface and saline water on the bottom. Historical records show that the salinity in the water at the bottom of the river is relatively constant at 30 parts per thousand (ppt). Salinity measurements taken in the Thames River adjacent to NSB-NLON in May of 1995 for the Supplemental Ecological Investigation confirmed the constant 30 ppt salinity level. Measurements ranged from 29.4 to 30.0 ppt taken near the bottom in the channel of the Thames River. The salinity of the water at the surface of the river is more variable, with the salinity ranging from 28 ppt at the mouth of the river to 2 ppt at the upstream end of the estuary at Norwich.

Surface water from NSB-NLON drains west toward the Thames River via streams and storm sewers. The offsite portion of these watersheds includes a sparsely developed residential area located to the east along Route 12 and an area with limited commercial development located north of the intersection of Crystal Lake Road and Route 12.

Significant onsite drainage features include several streams (perennial and intermittent), ponds, Rock Lake, North Lake, and a large wetland (Area A Wetland). Most of the major water bodies are shown on Drawing 1 (Volume III). The majority of these surface water features are located in the north central section of NSB-NLON. Six streams, three ponds, and North Lake are included in the Area Downstream Watercourses/OBDA site alone. These water courses drain to the Thames River through discharge points located at the DRMO, the Lower Subbase north of Pier 33, and at the Goss Cove Landfill.

More specific information regarding the watercourse and drainage features associated with each site investigated is provided in subsequent sections. Section 9.0 provides additional details regarding the Area Downstream Watercourses/OBDA. Section 4.6.5 provides a discussion of groundwater discharge to the river and the influence of tides and seasonal variations on the discharge. Section 17.0 provides additional details regarding the Thames River.

4.3.2 Surface Water Quality and Designation

The State of Connecticut Department of Environmental Protection (CTDEP) has classified the Thames River quality as SC/SB (see Drawing 1, Volume III). This classification designates the water for marine fish, shellfish, and wildlife habitat, certain aquaculture operations, recreational uses, industrial and other legitimate use, and indicates that the waters presently are not meeting water quality criteria or not supporting one or more designated uses as a result of pollution (CTDEP, 1992).

The quality of the surface water in the Thames River has been measured by the USGS upstream of NSB-NLON at Mohegan, Connecticut (USGS, 1993). Many depth-specific water quality parameters are measured by the USGS including pH, dissolved oxygen, hardness as CaCO_3 , and dissolved metals (e.g., iron, manganese, and lead).

Parameters such as pH, dissolved oxygen and total hardness varied depending on the time of year when the sample was collected and the depth from which it was collected. The pH of shallow surface water (1 foot) ranged from 6.3 (November 16, 1990) to 8.5 (July 9, 1991), while the pH of deep surface water (20 feet) ranged from 6.5 (November 16, 1990) to 7.9 (May 8, 1991). Dissolved oxygen in shallow surface water of the Thames River ranged from 13.2 mg/L (January 10, 1991) to 8.7 mg/L (September 9, 1991) and for deep surface water, it ranged from 8.8 mg/L (January 10, 1991) to 1.7 mg/L (July 9, 1991). The total hardness of shallow surface water ranged from 340 mg/L (May 8, 1991) to 1000 mg/L (July 9, 1991), while the total hardness of deep surface water ranged from 5000 mg/L (November 16, 1990) to 2300 mg/L (January 10, 1991).

Concentrations of dissolved metals in the surface water of the Thames River remained relatively constant over the sampling period (i.e., November 16, 1990; January 10, 1991; May 8, 1991; and July 9, 1991), but varied with depth. The average concentration of dissolved iron in shallow surface water was 84 $\mu\text{g/L}$ and in deep surface water was 25 $\mu\text{g/L}$. Average dissolved manganese concentrations ranged from 28 $\mu\text{g/L}$ (shallow surface water) to 61 $\mu\text{g/L}$ (deep surface water). The average concentration of dissolved lead in shallow surface water was 7.1 $\mu\text{g/L}$. This average is skewed due to a single high detection (27 $\mu\text{g/L}$) measured on July 9, 1991. In deep surface water, lead was not detected above method detection limits, therefore an average was not calculated.

4.4 SOIL CHARACTERISTICS

The United States Department of Agriculture Soil Conservation Service (SCS) has mapped the soils of NSB-NLON (SCS, 1983). According to the SCS report, soils at NSB-NLON have a moderate to moderately high permeability. Available water capacity is moderate to low. The soils are well drained and runoff is rapid. The pH of the soils indicate that they are strongly to moderately acidic, and the erosion hazard is severe.

Native soils across the facility consist of a dark, fine, sandy loam (Hollis and Charlton soils). Stones, boulders, and bedrock outcrops are prevalent on hills and ridges (the Hollis-Charlton-Rock Complex). The Hinkley Loam has been identified in the far northwestern portion of the facility. The soil is associated with stream terraces and outwash plains and consists of a dark, gravelly/sandy loam. Native materials along the Thames River were most likely of this type.

Altered soils at NSB-NLON have been classified as either Urdothents-Urban land or Urban land. The Urdothents-Urban land is defined as excessively to moderately drained soils that have been disturbed by cutting and filling. It is mapped in the northern portion of NSB-NLON in the Area A Downstream Watercourses and along the Thames River. Urban land is defined as areas where more than 85 percent of the surface is covered by streets, parking lots, and buildings. Urban land has been mapped in the southern portion of NSB-NLON and along the Thames River.

Manganese content of area soils was reviewed as this constituent emerged as a potential concern during the risk assessment. Nationwide the USGS reports background levels of manganese occurring at levels from less than 2 mg/kg to 7000 mg/kg (Shacklette and Boergen, 1984). In Connecticut, the USGS reports that manganese occurs in soils at levels from 150 to 700 mg/kg (Shacklette and Boergen, 1984).

4.5 GEOLOGY

NSB-NLON is situated in the Eastern Uplands region of Connecticut. The area has irregular hills of exposed bedrock and poorly drained, uneven valleys. The bedrock consists of metamorphosed rocks of sedimentary and igneous origin. The bedrock has been faulted and folded. A major east-west trending fault (The Honey Hill Fault) is located approximately 6 miles north of NSB-NLON. The fault does not intersect the facility.

Detailed descriptions of the regional geology are provided in the Phase I RI Report (Atlantic, 1992) and the Initial Assessment Study Report (NEESA, March 1983). The following subsections summarize the geologic

setting of NSB-NLON and provide a description of the bedrock surface and structure. Site-specific geological descriptions are provided in Sections 5.0 through 17.0.

4.5.1 Geologic Setting

According to the bedrock map (USGS, 1967), the NSB-NLON facility is underlain by the bedrock of five different formations: Alaskite Gneiss, Granitic Gneiss, Mamacoke Formation, Plainfield Formation, and Westerly Granite. The Alaskite Gneiss and Granitic Gneiss are orange-pink to light gray, medium-grained granitic gneisses. The Mamacoke Formation is a light to dark gray, medium-grained biotite-quartz-feldspar gneiss. The Plainfield Formation is a dark green hornblende-biotite-quartz-plagioclase gneiss. The Westerly Granite consists of gray, fine- to medium-grained equigranular granite.

Most of the surficial deposits in the area are unconsolidated glacial materials that were deposited during the Pleistocene Age. There are two types of glacial deposits at the facility, stratified drift and glacial till. Stratified drift consists of sorted silt, sand, and gravel that were deposited by meltwater streams. Stratified drift is located on terraces of the Thames River and is mapped along the western portion of the facility (USGS, 1960). Glacial till consists of a dense, heterogeneous mixture of clay, silt, sand, and rock fragments as large as boulders. Glacial till is exposed on most of the bedrock highs and most likely underlies outwash materials in the valleys. The thickness varies considerably but averages less than 10 feet.

The remainder of the surficial deposits are the product of post-glacial river/floodplain processes and manmade modifications. Quaternary alluvium that consists of sand, silt, and gravel has been mapped in the area of the Area A Wetland (USGS, 1960). Artificial and natural fill are prevalent at the sites under investigation.

4.5.2 Bedrock Surface and Structure

Drawing 4 (Volume III) is a facility-wide bedrock surface map. Bedrock elevations were determined as the ground surface elevation minus the depth-to-bedrock reported on the boring logs for the test borings and monitoring wells.

The eastern edge of the facility is bordered by a bedrock high known as Baldwin Hill. The bedrock along this hill slopes toward the facility. There are three bedrock highs along the northern, central, and southern portions of the facility. At higher elevations (i.e., greater than 120 feet) these hills mimic the topographic surface. The depth to bedrock at wells 4MW1S through 4MW4S along the central hill and well 2WMW1D

along the eastern hill is less than 10 feet. On the top of the central hill, a depth to bedrock of 2 to 7 feet was measured in 2LMW36B and 2LMW35B, respectively. For other bedrock highs where no data was available, a depth to bedrock of 10 to 15 feet was assumed. Inferred contour lines on Drawing 4 are shown as dashed.

In the two nearly east-west trending valleys between the bedrock highs, the bedrock surface continues to decrease along slopes similar to the hills whereas the topographic surface flattens. In the northern valley, the bedrock surface decreases to a general elevation of 30 feet. The overburden thickness is typically 20 to 30 feet, however, it is thicker in the eastern portion of the valley in the vicinity of the Area A Wetland. There are three oblong-shaped bedrock highs that protrude within the valley. On these hills, the depth to bedrock is less than 10 feet. The southern valley is broader, and the bedrock elevation decreases to below mean sea level and the overburden thickens to greater than 50 feet. There is one bedrock outcrop to the northeast of the Goss Cove Landfill along Shark Boulevard. The depth to bedrock is 12 feet at the Goss Cove Landfill as determined from boring logs for well cluster 8MW2.

Along the Thames River, the bedrock surface decreases to elevations of 66 (6TB17) and 82 (6MW2D) feet below msl. These elevations are below the bottom of the Thames River, which has an approximate depth of 40 feet. Bedrock contour lines are inferred along the Thames River where no data are available.

Of the five different types of bedrock, only the biotite-quartz-feldspar gneiss of the Mamacoke Formation and the Granitic Gneiss were identified during drilling, as documented in the boring logs for site-specific investigations. The Mamacoke Formation was identified at the CBU Drum Storage Area, Area A Landfill, Area A Downstream Watercourses, Rubble Fill Area at Bunker A86, OBDA, Torpedo Shops, OBDANE, Spent Acid Storage and Disposal Area, and Goss Cove Landfill. The Granitic Gneiss was identified at the Area A Weapons Center. Both formations were identified within the Area A Wetland and the DRMO. The bedrock surface was not encountered at the Lower Subase.

During the Phase II RI, 7 strike and dip bedding measurements and 4 joint orientation measurements were taken along outcrops between the northern and central ridges. Drawing 4 (Volume III) shows the strikes and dips at these locations. The strike ranges from N29W to N76W. In most cases, the dip ranges from 24 to 60 degrees northeast. In two cases, the dip is to the southwest. Joints are oriented primarily to the northeast, although one is oriented to the southwest.

4.6 HYDROGEOLOGY

This section provides a summary of hydrogeologic conditions at NSB-NLON. Brief discussions of groundwater quality and designations, aquifer characteristics, and groundwater flow are provided.

4.6.1 Area Hydrogeology

For the State of Connecticut, the USGS National Water Summary (USGS, 1986) reports that "...groundwater beneath more than 90% of the land in the state is considered to be suitable for drinking without treatment...". Saltwater intrusion impacts groundwater in coastal areas. Other points of interest include that groundwater is hard to very hard in 70% of the wells in the state's carbonate rock aquifer, 40% of the wells in the state's sedimentary rock aquifer, and 15% of the wells in the stratified drift and crystalline bedrock aquifers. NSB-NLON can be characterized as being located in the stratified drift and crystalline bedrock aquifers of the state. The report also states that "large concentrations of iron (as large as 40,000 $\mu\text{g/L}$) and manganese (as large as 14,000 $\mu\text{g/L}$) are a common natural groundwater-quality problem in Connecticut."

There are several well water users in the vicinity of NSB-NLON. These include the Groton Water Department, the Southeastern Connecticut Water Authority (SECWA), the town of Ledyard and residences adjacent to the base. The Groton Water Department supplies potable water to NSB-NLON. The primary source of the Groton water supply is reservoirs which are supplemented with wells. The water supplies are located within the Poquonock River Watershed, located east of NSB-NLON, which is not within the NSB-NLON watershed.

4.6.2 Groundwater Quality

4.6.2.1 CTDEP Groundwater Classifications

CTDEP has classified the groundwater beneath NSB-NLON as GB (see Drawing 1, Volume III). A classification of GB indicates that the groundwater may not be suitable for direct human consumption without treatment as a result of waste discharges, spills, chemical leaks, or land use impacts. GB waters may be useful for industrial process waters or cooling waters.

The groundwater north and east of NSB-NLON is classified by CTDEP as GA (see Drawing 1 in Volume III). The GA classification signifies groundwaters presumed suitable for direct human consumption without the need for treatment.

4.6.2.2 Local Background Groundwater Quality

SECWA uses groundwater to provide potable water to residents in areas north, east, and northwest of NSB-NLON. Water quality data collected in 1991 and 1994 from 16 SECWA divisions was obtained from the water authority. The data and a sample location map are included in Appendix C.5. A summary of the 1994 data is presented in Table 4-1. Iron and manganese were not part of the analytical suite. From the table it can be seen that barium, sodium, chloride, fluoride, sulfate, nitrates and nitrites were detected in the groundwater.

The Town of Ledyard also uses groundwater to provide potable water to its residents. The Ledyard Water Pollution Control Authority (WPCA) monitors groundwater constituents. Concentrations of iron and manganese measured in Well #1 in the Highland Well Field were obtained by NSB-NLON from the WPCA. This well is approximately 6 miles northeast of NSB-NLON. The data obtained included 7 sampling rounds, all from July and August of 1995. The concentrations of iron ranged from 2,170 $\mu\text{g/L}$ to 2,780 $\mu\text{g/L}$. The concentrations of manganese ranged from 1,100 $\mu\text{g/L}$ to 1,400 $\mu\text{g/L}$. The analytical results did not indicate whether they were total or dissolved concentrations.

Homes on Route 12 adjacent to the northeast portion of the site have private drinking water wells, as do homes north of NSB-NLON on Sleepy Hollow Road, Long Cove Road, and Military Highway. The quality of the groundwater in these areas was measured by Atlantic and is summarized in the Off-site Residential Well Water Data Evaluation Report (Atlantic, July 1994d). Manganese concentrations measured in these residential wells ranged from less than 0.7 to 2,130 $\mu\text{g/L}$, while iron concentrations ranged from less than 4.8 to 21,800 $\mu\text{g/L}$. Two trailer parks near the site have wells classified as public water supply wells. The Colonel Ledyard Mobile Home Park, located on Sleepy Hollow Road adjacent to the North Gate has a well that supplies between 15 and 20 families. The Grandview Trailer Park, located at the intersection of Long Cove Road and Route 12, has two water supply wells. There are several irrigation wells onsite at the golf course which have not been used for several years.

4.6.2.3 NSB-NLON Soil, Sediment and Groundwater Quality

Based on review of the analytical data for monitoring wells located throughout the NSB-NLON facility, it was determined that soils and bedrock throughout the area may contain high concentrations of some naturally-occurring chemicals. Manganese is of specific interest since risks associated with manganese in groundwater were predicted to be relatively high at many sites. Tables 4-2 and 4-3 summarize the manganese concentrations in solid and aqueous matrices, respectively. Table 4-2 includes background soil

and sediment concentrations, site-specific sediment concentrations, and site-specific concentrations in surface and subsurface soil at each of the individual sites. Table 4-3 presents the manganese concentrations in groundwater samples collected from off-site wells and site-specific shallow and deep wells.

As shown in Table 4-2, manganese concentrations in soil generally range to no more than 400 mg/kg at most of the sites. Exceptions include the detection of relatively high manganese concentrations in the soil at the Area A Landfill (maximum = 1150 mg/kg), DRMO (maximum = 1,260 mg/kg), Torpedo Shops (maximum = 725 mg/kg), and Goss Cove Landfill (maximum = 1080 mg/kg). At the Torpedo Shops, only one sample out of 22 soil samples collected at the site had a detection of manganese that exceeded 457 mg/kg. The maximum concentrations of manganese at these sites exceed the background value determined for manganese for NSB-NLON (See Table 4-2), but none of the concentrations exceed the range of manganese concentrations detected in soils of the eastern United States by the USGS and most are in the range reported for Connecticut (See Section 4.4 and Table 4-2).

From Table 4-2 it can be seen that the manganese concentrations in sediment generally range to no more than 500 mg/kg at most of the sites at NSB-NLON. Exceptions include the detection of relatively high manganese concentrations in the sediment at the Area A Weapons Center (maximum = 2640 mg/kg) and the Area A Downstream Watercourses/OBDA (maximum = 2,850 mg/kg). Sediments were collected in 3 water bodies close to NSB-NLON to serve as references for the Phase II RI Supplemental Ecological Investigation. The maximum concentrations at the two NSB-NLON sites are within the same order of magnitude, but approximately double the maximum concentration of manganese detected in the sediment of the reference waterbodies (maximum = 1240 mg/kg; Table 4-2).

Table 4-3 presents the manganese concentration ranges for filtered and unfiltered groundwater samples from shallow and deep monitoring wells. Manganese concentrations in offsite residential wells located upgradient of NSB-NLON ranged as high as 2,130 $\mu\text{g/L}$. These levels are typical of most wells on the base. Maximum concentrations of manganese in groundwater at several sites at NSB-NLON exceed the offsite concentrations by less than one order of magnitude.

Isoconcentration contours for manganese (total and dissolved), iron (total) and pH, in overburden and bedrock, are provided in Drawings 5 through 12 (Volume III). Iron data was plotted because iron and manganese are often associated in groundwater under natural conditions. Comparison of these figures to bedrock surface contours (Drawing 4) and potentiometric surfaces suggest the following relationships: the landfill and dredge spoils are within a depression in the bedrock which controls groundwater flow and groundwater flows towards the Thames River (see Section 4.6.4); within the depression pH is depressed

by one unit, and manganese and iron are elevated; data to the east of the base is not sufficient to determine whether these characteristics occur to the east beyond the base boundary and away from the Thames River.

The drawings indicate that total and dissolved concentrations of manganese in groundwater are similar, indicating that the manganese is dissolved in the groundwater. In general, the drawings show that the maximum concentrations of manganese were detected in the Area A Wetland, the Area A Downstream Watercourses/OBDA near Streams 1 and 5, and the Torpedo Shops in monitoring well 7MW5D. Many other areas of NSB-NLON had limited or no data available and conclusions could not be drawn about the concentration of manganese in groundwater for those areas.

The drawings also indicate that the concentrations of manganese are slightly higher in the overburden groundwater than the bedrock groundwater. The maximum concentration of manganese in the overburden groundwater was 9,360 $\mu\text{g/L}$, while the maximum concentration in the bedrock groundwater was 7,630 $\mu\text{g/L}$.

The maximum concentrations of iron detected in the shallow overburden and bedrock groundwater were 141,000 $\mu\text{g/L}$ (Goss Cove Landfill) and 108,000 $\mu\text{g/L}$ (Area A Wetland), respectively. Areas of NSB-NLON that had high concentrations of manganese also had high concentrations of iron. These areas included the Area A Wetland, Area A Downstream Watercourses/OBDA, and the Torpedo Shops.

The pH plotted on the drawings was measured in the field during Round 2 of the Phase II RI. The pH of the shallow and deep groundwater ranged from approximately 5 to 9. Higher pHs (>9) were only detected in the shallow overburden groundwater (Lower Subbase and Area A Downstream Watercourses), while lower pHs (<5) were detected in both the shallow and deep groundwater (Spent Acid Storage and Disposal Area and Area A Downstream Watercourses). The pH of the shallow and deep groundwater in the Area A Landfill and Wetland ranged from 6 to 8. The pH of 8 was measured in a deep well along the upgradient edge of the NSB-NLON. The pH of the groundwater decreases moving in a downgradient direction towards the dike of the Area A Wetland. This decrease in pH may be a result of the anerobic conditions present in the Area A Wetland. The pH of the deep groundwater in the area upgradient of the Torpedo Shops and Area A Weapons Center was around 8. The pH of groundwater around the Rubble Fill Area at Bunker A86 which is upgradient of the Area A Landfill and Wetland is approximately 6.

Based on a review of the pH maps, there is a potential that there are sources contributing to higher (basic) and lower (acidic) pH zones in groundwater at NSB-NLON. However, when reviewing the manganese and iron maps jointly with the pH maps, there is not a clear relationship between low pH and high dissolved

metal concentrations. The occurrence of manganese and iron in the groundwater may be due to either natural sources (i.e., local geologic units) or man-made sources such as dredge spoils from the Thames River or leachate from the municipal solid waste ash placed in the Area A Landfill. Both scenarios fit the available data and background information.

4.6.3 Aquifer Characteristics

During the Phase II RI, slug tests were performed on 7 wells. The data were analyzed and values of hydraulic conductivity were estimated using the Bouwer and Rice Method (Bouwer and Rice, 1976). The data and calculations are provided in Appendix C.1 (Slug Test Calculations). Table 4-4 summarizes the estimated values of hydraulic conductivity for each well. Although some wells have a designation of "D," only well 4MW2S is screened in bedrock. The hydraulic conductivity for 4MW2S is 3.35 feet/day ($1.18\text{E-}3$ cm/sec), and the well is screened mostly in bedrock but partially in overburden described as boulders.

The other wells are screened exclusively in overburden materials. Values of hydraulic conductivity ranged from 0.07 to 20.3 feet/day ($2.47\text{E-}5$ to $7.16\text{E-}3$ cm/sec). The highest value is from a well screened in loose sand and gravel near the Thames River (6MW3D). Intermediate values between 1 and 5 feet/day are for wells screened in the shallow fill and terrace deposits consisting primarily of dense, coarse sand with some gravel and silt. The lowest values of hydraulic conductivity, which are less than 1 foot/day, are from wells screened in very dense, silty sand in the shallow overburden (e.g., 15MW3S) and dense, poorly sorted sand in the deeper overburden (e.g., 8MW2D). The results indicate that the overburden materials are generally moderately permeable. Due to the limited database and the fact that some wells are screened across multiple lithologies within the overburden, detailed evaluations of the hydraulic characteristics of differing types of overburden materials cannot be made.

A pumping test was performed at well 2LPW1S during the Phase II RI. The test was initiated on April 28, 1994 and continued for a total of 4,300 minutes (approximately 3 days). The pumping rate was maintained at 2.0 gpm throughout the test. A low pumping rate was required to maintain water above the bottom of the pumping well screen throughout the test. Twenty-one wells were monitored for drawdown, but only wells 2LOW1S (10.5 feet from the pumping well) and 2LOW2S (24.5 feet from the pumping well) had measurable drawdown that corresponded to the pumping activities. After 4,300 minutes, the pump was shut off, and recovery was monitored in all of the wells. Trend data showed that water levels were declining in the area, and recovery occurred only in the pumping well 2LPW1S, and observation wells 2LOW1S and 2LOW2S.

The drawdown data at wells 2LOW1S and 2LOW2S were analyzed according to the Neuman curve-matching technique (Kruseman and deRidder, 1989). Table 4-5 shows the results of these analyses. The data and calculations are included in Appendix C.2 (Pumping Test Calculations). The estimated values of transmissivity (T), storativity (Ss), and specific yield (Sy) are higher for the data at well 2LOW1S than at well 2LOW2S. The estimated specific yield at 2LOW1S was calculated to be greater than one. Specific yield values above 0.4 are atypical, while a specific yield of greater than 1 is physically impossible. Although well 2LOW2S is farther from the pumping well than 2LOW1S, the drawdowns at 2LOW2S and 2LOW1S are similar. The unreasonable calculated specific yield at 2LOW1S may be due to anisotropic conditions in the aquifer or well casing storage effects. The calculated specific yield of 0.24 at 2LOW2S is a more reasonable value and is considered to be representative of the aquifer. The calculation of T is independent of time variables (which S is derived from), thus anomalous S_y values should not adversely impact calculations of T and K. The estimated hydraulic conductivities at these wells are 2.1 and 3.5 feet/day ($7.4E-4$ and $1.23E-3$ cm/sec). These values are similar to hydraulic conductivity results determined from the Phase II slug test data.

The T, K, and S_y estimates obtained from the 2LOW2S data are considered more reliable and representative of overall aquifer conditions than those obtained from the 2LOW1S data. The greater distance of 2LOW2S from the pumping well results in data representative of a larger portion of the aquifer, and less sensitivity to local anisotropic conditions.

4.6.4 Comprehensive Water Level Investigation

The following two subsections provide a general description of groundwater flow and vertical components of groundwater flow at NSB-NLON. Site-specific discussions of groundwater flow are provided in Sections 5.0 through 17.0.

4.6.4.1 General Discussion of Groundwater Flow

The general direction of groundwater flow at NSB-NLON is from Baldwin Hill across the facility to the west (toward the Thames River). However, the water table surface locally mimics the bedrock (and topographic) surface. High hydraulic potentials develop within the three bedrock highs in the northern, central, and southern areas of the facility. Precipitation infiltrates into the overburden and bedrock and flows radially from the areas of high bedrock (and topographic) elevation toward areas of low bedrock (and topographic) elevation. More specifically, groundwater flows toward the two valleys and ultimately toward the Thames River or directly from the western edges of the three hills toward the Thames River.

Two comprehensive rounds of water level measurement were completed in March and August 1994. A third comprehensive round of water levels was obtained in November 1995. The wells used for water level measurements included the Phase II RI wells and selected pre-existing wells. The November round also included post-Phase II RI Area A Landfill and Tank Farm wells, along with some residential wells not previously measured. Water levels were also measured at staff gauges that were installed during and after the Phase II RI. Table 4-6 shows the reference elevation, depth to water, and water elevation for the three measurement rounds.

Drawings 13, 14, and 15 (Volume III) show potentiometric surface maps for the shallow overburden for the three comprehensive rounds of water levels. As indicated on Drawings 13, 14, and 15, saturated overburden materials were encountered within and along the valley margins at the Subase. In areas of higher ground surface (and bedrock surface) elevation, the overburden materials were typically not saturated. Drawings 16, 17, and 18 show shallow bedrock groundwater contours for the three water level rounds.

Groundwater elevations were generally lower in August than in March. November 1995 water levels were similar to the August 1994 levels. Seasonal variations in water levels are discussed in Section 4.6.4 (Monthly Water Level Investigation).

In most cases, the groundwater elevations at well clusters are similar in the bedrock and overburden. This suggests that the bedrock and overburden are hydraulically connected and that the groundwater flow directions are similar in both, as is evident by comparing the overburden and bedrock flow maps. At a few well clusters, the difference in groundwater elevations between the bedrock and overburden is greater than several feet. In these areas the bedrock and overburden have a weak hydraulic connection, and local groundwater flow directions may vary. Dashed (inferred) contours were drawn based on topography and the bedrock surface elevation in areas where no data are available.

Limited water level data obtained in November 1995 from offsite wells (Drawings 15 and 18) show that groundwater in areas to the east of NSB-NLON are at higher elevations than along the eastern boundary of NSB-NLON, indicating that groundwater at NSB-NLON does not migrate offsite to the east. To the north, offsite wells have relatively low water levels, however they are located in a valley on the opposite side of a large ridge that separates the waste disposal areas at NSB-NLON from these wells. The ridge acts as a local groundwater divide, preventing migration of groundwater from the northern waste disposal areas at NSB-NLON to these offsite wells.

A drainage basin map of Connecticut (Connecticut Geological and Natural History Survey, 1974) shows that a major basin divide occurs along the ridges of Baldwin Hill. To the east of Baldwin Hill, water (both surface and subsurface) is part of the Southeast Coast Major Basin. Water from this basin is not expected to travel toward the facility. To the west of Baldwin Hill, water is part of the Thames Major Basin. Surface and groundwaters ultimately discharge into the Thames River.

Hydraulic gradients in the bedrock are greatest where the bedrock surface slope is steepest (along the hillside at Rubble Fill at Bunker A86) and decrease where the bedrock slope is milder (in the valley at Area A Downstream Watercourses). Table 4-7 shows the bedrock slope and hydraulic gradient across four transects within the bedrock. As shown in the table, the hydraulic gradient decreases as the bedrock slope decreases.

Table 4-8 shows the hydraulic gradients across four transects in the overburden. Two of the transects are in the Area A Weapons Center and two are in the lower region of the Area A Downstream Watercourses. As groundwater travels toward the Thames River, the hydraulic gradient is influenced by the elevation of the Thames River. If the Thames River water level is low, the hydraulic gradient steepens as groundwater approaches the river. If the river elevation is higher, the hydraulic gradient flattens or even reverses its direction (e.g., at high tide). The 2DMW25S/2DMW28S and 2DMW27S/19MW4 transects of Table 4-8 indicate that the hydraulic gradient steepens toward the Thames River. This is probably a function of tidal effects (water levels were obtained near low tide).

4.6.4.2 Vertical Components of Groundwater Flow

The vertical component of groundwater flow is predominantly downward in upland areas of NSB-NLON. However, at the base of the hills, the bedrock surface flattens and the overburden thickens. In these areas, upward gradients may occur, resulting in shallow bedrock groundwater discharge into the overburden. Near the Thames River, upward gradients exist, as is typical for groundwater in major stream valleys. Whether an upward or downward gradient develops depends on factors such as the bedrock configuration, depth of the overburden, topographic features, permeability, distance to the river and the tides.

Vertical gradients have been calculated at select well cluster locations and are shown in Table 4-9. One trend evident in the data is an upward vertical gradient that has been witnessed at the majority of the Area A landfill and wetland well clusters (2LMW7S/D, 2LMW8S/D, 2LMW13S/D, 2LMW17S/D, 2LMW20S/D and 2WMW6S/D). Presumably, the Area A Wetland acts as the discharge point for groundwater in this area,

thus supported by the observed upward groundwater flow potential from the bedrock, through the overburden, discharging to the Area A Wetland.

Cross-sections A-A' and B-B' are shown on Drawing 3 (Volume III). Cross-sections C-C' through K-K' are shown on Drawing 19 through Drawing 21 (Volume III). These cross-sections show the ground surface, bedrock surface, potentiometric surface, and lithology. Additionally, where trends could be identified, groundwater potentials and flow directions are shown. The cross-section locations are shown on Drawing 2 (Topographic Surface and Cross-Section Location Map) included in Volume III. Cross-sections A-A' and B-B' are conceptual in nature and display general geologic features for north/south and east/west cuts through NSB-NLON.

Cross-section C-C' (Drawing 19) runs north-south across the DRMO and parallel to the Thames River. This area is underlain by 5 to 25 feet of fill material, a silt layer, and a sand/gravel layer. The silt and sand/gravel layers have been mapped as stratified drift (USGS, 1960), but deposits may also be former floodplain deposits of the Thames River. Groundwater flow is toward the Thames River. An upward gradient from the sand/gravel layer to the fill material occurs at the 6MW2D well cluster. A vertical gradient from the bedrock cannot be determined, because the only bedrock well, 6MW3D, is damaged.

Cross-section D-D' (Drawing 19) runs in a southwest direction from the northern bedrock high (Torpedo Shops), across the Area A Downstream Watercourses, and toward the Thames River. The bedrock surface elevation is highest along the northern hills. The cross-section intersects the central ridge at the 2DMW27 well clusters, and the bedrock elevation increases toward the central ridge. The overburden between the two hills consists of a thin layer of fill that is underlain by silt and sand. The sand and silt are either present-day stream/floodplain deposits or stratified drift of glacial streams. Overall, groundwater moves from the high bedrock elevations toward the Thames River. A downward vertical gradient occurs at all four well clusters. In the area of the 2DMW25 well cluster, groundwater flows radially from the northwest corner of the central bedrock high. On the cross-section, this appears as two opposing directions of flow.

Cross-section E-E' (Drawing 19) runs in a southwest direction across the central portion of the northern valley. Between the northern and central bedrock surface highs, the bedrock surface does not uniformly slope to the middle of the valley. Instead, there are two localized mounds in the bedrock surface. They are located in the middle of the Area A Wetland at 2WTB4 and to the northeast of 2WTB6 at the Area A Weapons Center. The overburden consists of miscellaneous fill and dredge spoils that are underlain by sand and silt deposits. Groundwater flow is artesian at well cluster 4MW4S (flowing conditions were observed during both the March, August and November 1994 rounds). There is an upward gradient and the bedrock

groundwater discharges to the overburden at well cluster 2LMW7. There is most likely a higher groundwater potential near 2WTB4 that results in radial discharges to the overburden and recharge to the wetland area.

Cross-section F-F' (Drawing 20) runs in a southeast direction from the Thames River to the eastern portion of the Area A Wetlands. Because the cross-section cuts through the boundaries of the northern bedrock high, the bedrock surface appears to be irregular. The bedrock surface generally slopes toward the Thames River. The overburden consists of fill and stratified drift. Lateral groundwater flow is generally to the west toward the Thames River. The vertical component is generally downward, however, there is a localized upward component at well cluster 2WMW5D.

Cross-section G-G' (Drawing 20) runs southeast from the 2DMW28 well cluster in the golf course, up the central hill to the 4MW4 well cluster, and down the central hill to the eastern portion of the wetlands. The cross-section covers much of the Area A Landfill (2L wells). The overburden at the landfill consists of dredge spoils, fill, and stream/floodplain deposits. Groundwater flows west from the 4MW4 well cluster toward the Thames River. There are upward gradients at the 2LMW13, 3MW12, and 2DMW28 well clusters. Upward gradients exist from the 4MW2 well cluster toward the southeast (i.e., at well clusters 2LMW17, 2LMW19, and 2LMW20). There is a downward component from the overburden to the shallow bedrock at the 2LMW18 well cluster. This is believed to be a result of the steep slope in the bedrock and the thick overburden.

Cross-section H-H' (Drawing 20) runs east across the Lower Subase from 13MW8 to 13MW2. The overburden consists of sand and gravel fill that is underlain by silt near the Thames River. The silt has been mapped as stratified drift (USGS, 1960). Groundwater flows toward the Thames River. Although the depth to bedrock is unknown, the bedrock surface probably decreases toward the Thames River as it does at the DRMO and Goss Cove Landfill. The slightly irregular groundwater elevations between 13MW19 and 13MW2 are probably the result of a local irregularity in the bedrock surface or differences in the permeability of the overburden. Because no bedrock wells were installed, vertical gradients from the bedrock to the overburden could not be determined.

Cross-section I-I' (Drawing 21) runs south across the Lower Subase from 13MW8 to 13TB6. The fill has a maximum depth of approximately 20 feet. The top elevation of the underlying silt layer ranges from 6 to 13 feet below msl. As for cross-section F-F', the groundwater elevations vary. These variations cannot be correlated to known variations in overburden thickness or irregularity of the bedrock surface.

Cross-section J-J' (Drawing 21) runs south across Goss Cove Landfill from 8TB7 to 8MW6D. The overburden consists of 15 to 25 feet of fill material that is underlain by three definable layers of silt, sand, and silty sand. These deposits have been mapped as stratified drift (USGS, 1960), but may also be modern stream deposits of the Thames River. The depth to bedrock is greater than 85 feet. Groundwater flows inland from the Thames River, most likely due to high tide conditions in the Thames River towards a low at 8TB1 and 8MW1. Groundwater from 8MW5S flows towards the low at 8MW1. There is a downward flow component from the fill material to the underlying natural materials within the overburden.

Cross-section K-K' (Drawing 21) runs east from the Thames River near Goss Cove Landfill across the southern valley to the Spent Acid Storage and Disposal Area. The cross-section cuts across the bedrock high that is located upslope of Goss Cove Landfill. To the east of this bedrock high, the depth to bedrock is unknown, so the bedrock surface slope and extent of the high into the southern valley is estimated on the cross-section. Groundwater flow is towards the Thames River and there is a consistent downward gradient. Although wells OGB-7 and ERM-4 are not shown on the cross-section, the high groundwater elevations at these wells suggest that the hydraulic gradient is relatively flat within the southern valley. The hydraulic gradient steepens as the bedrock elevation increases and then flattens near the Thames River as the bedrock elevation decreases.

4.6.5 Monthly Water Level Investigation

Water level measurements were collected on a monthly basis between March 31, 1994 and February 23, 1995, during the Phase II RI. Measurements were made at 46 wells and 3 staff gauges. Table 4-10 presents the groundwater elevations for each date of collection. A heavy rain occurred on the day before the May 26th round, and a light rain occurred on the day before the August 23, 1994 round.

Appendix C.3 (Monthly Hydrographs) contains hydrographs (water elevation versus time). Hydrographs were prepared for selected wells and well clusters using water level data collected from March 31, 1994 to February 23, 1995. In general, groundwater elevations were highest in March and decreased from March through the summer months. Groundwater elevations increased in August. Although similar groundwater elevations were observed in September, they decreased in some wells and increased in others. Overall, the groundwater elevations dropped in October to approximately the lowest values observed. Groundwater elevations tended to increase from October to December. During January and February, groundwater elevations tended to increase but trends for certain regions of NSB-NLON varied.

The water level elevations correlate well with precipitation data for Groton provided by the Northeast Regional Climate Center in Ithaca, New York. Total monthly precipitation from March 1994 through February 1995 was as follows (inches): March - 7.68; April - 2.17; May - 2.51; June - 1.53; July - 0.85; August - 6.95; September - 3.99; October - 1.15; November - 5.49; December - 5.19; January - 3.14; February - 3.92.

The hydrographs for OSW12, 2WMW22D, 2WMW2D, 2LMW19D, and 2WMW5D demonstrate the seasonal water level variations in the bedrock in the eastern portion of the northern valley (Area A Wetland area). Well OSW12 is located at the highest topographic and bedrock elevation of all of the monitored wells and has the highest measured groundwater elevation. This well had the highest variability in groundwater elevations as indicated by a standard deviation of 4.07 feet. Water levels for this well ranged from a high of 131.79 ft msl to a low of 118.05 ft msl. The water level fluctuations in this well are probably reflective of (1) the shallow depth to groundwater, (2) precipitation events, and (3) the fact that groundwater at this bedrock high point is not affected by recharge in other areas. Wells 2WMW22D, 2WMW2D, and 2LMW19D are located at lower bedrock elevations. The variation in the groundwater elevations at these wells are less than at OSW12 (i.e., range of standard deviation of 2.93 feet at 2WMW22D to 3.48 feet at 2WMW2D). Water levels for these wells ranged from a high of 104.53 ft msl in 2WMW22D to a low of 73.8 ft msl in 2LMW19D. Well 2WMW5D is located at the lowest bedrock elevation where the overburden is thickest. The variation in the groundwater elevation at this well is the lowest of the wells in this area as indicated by the standard deviation of 0.77 feet. Water levels for this well ranged from a high of 74.25 ft msl to a low of 71.28 ft msl. Water level variations in this area are most likely moderated by recharge from upland areas.

Review of water level data for the 2WMW5, 2LMW19, and 2LMW7 well clusters indicates that the bedrock and overburden wells exhibit similar monthly water level trends. Increases in the bedrock groundwater elevations are reflected by overburden water levels, demonstrating the hydraulic connection between the overburden and bedrock. Upward hydraulic gradients exist in the vicinity of these well clusters.

Well 2DMW23D is located along the northern bedrock high in the western portion of the northern valley (Area A Downstream Watercourses). Water level variability was greatest at this location and ranged from a high of 64.55 ft msl to a low of 44.84 ft msl. Water level data for the 2DMW24 well cluster, which is in the northern valley downgradient of 2DMW23D, exhibit similar monthly water level trends in the bedrock and overburden, revealing the hydraulic connection between the lithologic units.

The hydrographs for staff gauges SG-5 and SG-6 show small variations in surface water elevations. Staff gauge SG-6 is located in the Area A Wetland near the outfall to the Area A Downstream Watercourses and

staff gauge SG-5 is located in Stream 3 just west of the Torpedo Shops. The small variation in surface water elevations at SG-6 is most likely attributable to precipitation events or evaporation. Discharge from the Area A Wetland would increase as a result of hydrostatic head increases attributable to precipitation events which moderate water level fluctuations. The limited variations in the surface water elevations measured at SG-5 may be attributable to the connection of the stream and the water table. The surface water elevations at staff gauge SG-5 show some correlation with the groundwater elevations measured in well 7MW8S (Table 4-5) which is the closest well to the staff gauge and well 7MW3D which is upstream of the staff gauge and very close to the watercourse (Table 4-8). A comparison of the surface water elevations at SG-5 and the groundwater elevations at 7MW8S shows that the stream was a gaining stream in March, 1994 (surface water elevation of 39.07 feet msl at SG-5 and a groundwater elevation of 39.41 feet msl at 7MW8S), and a losing stream in August, 1994 (surface water elevation of 38.85 feet msl at SG-5 and a groundwater elevation of 38.03 feet msl). In addition, the trends (i.e., changes with time) in the surface water elevations at staff gauge SG-5 are generally similar to the trends of the groundwater elevations at well 7MW3D, which indicates a connection between the surface water body and the water table.

Water level measurements for wells along the Thames River indicate that groundwater elevations along the Thames River are tidally influenced. For example, at well 13MW8 which is approximately 20 feet east of the river, the groundwater elevation varied from approximately 1 to 3.5 feet, and high tide reaches approximately 3 ft msl (Section 4.6.5 provides a discussion of tidal influence). The hydrograph for 13MW8 shows no monthly trend reflective of precipitation. The observed variability for this well is most likely attributable to tidal influences.

4.6.6 Groundwater Discharge and Tidal Influence

Based on studies conducted during the Phase I and II RIs and an investigation at Building 31 completed by Halliburton NUS (HNUS, May 1993b), the groundwater potentials have been shown to vary as a result of tidal and seasonal influences. Specific information regarding tidal and seasonal influences is provided in the remainder of this section.

4.6.6.1 Tidal Influences on Groundwater Discharge

The tides of the Thames River influence the discharge of groundwater from NSB-NLON on a daily basis. Under normal flow conditions in the river, the discharge of groundwater to the Thames River is greatest at low tide. The hydraulic gradient along the river will be steepest during low tide. During high tide conditions, the elevation of the river is higher than the groundwater elevations observed along the western perimeter

of the facility, which creates localized reversed gradients and consequently reverses flows. Two small studies, both in the vicinity of the Lower Subase, have been completed which verify this pattern of water level changes.

The first tidal study was conducted on April 18, 1991 during the Phase I RI (Atlantic, August 1992). Water levels in 16 Lower Subase wells and points on the river were monitored hourly during a 12-hour tidal cycle to determine the effects of the tide on groundwater discharge at this site. Groundwater elevations under low and high tide were contoured to determine the flow trend. The contours showed that at low tide groundwater flows west toward the Thames River. They also indicated that at high tide, groundwater flows east from the river in the western portion of the Lower Subase and flows west toward the river in the eastern portion of the Lower Subase, with a low groundwater elevation occurring in the center of the site where the opposing gradients meet. The study demonstrated that the tidal effects diminish with distance from the river. The reversal of groundwater flow direction at high tide did not extend farther than 300 feet inland of the river.

The second tidal study was completed in February of 1993 as part of a larger investigation at Building 31 by Halliburton NUS under a separate contract (Contract Task Order 112). Two Hermit data loggers and two transducers were installed, one in a temporary well and the other in the Thames River, to complete the 40-hour study. The two monitoring points were approximately 105 feet apart. The study showed that tidal changes of approximately 2.22 feet occurred in the Thames River, which created reversals in groundwater flow directions within the Lower Subase every tidal cycle. Water levels in the monitoring well fluctuated by 1.19 feet during the same time frame.

Based on the information discussed above, the following conclusions were reached regarding tidal influences of groundwater discharge from NSB-NLON: (1) During low tide, the hydraulic gradient of the groundwater table at NSB-NLON is towards the Thames River and will result in the highest discharge rate of groundwater to the river; (2) During high tide, the hydraulic gradient of the groundwater at NSB-NLON along the Thames River is reversed and flow occurs from the river to the site, temporarily halting the discharge of groundwater from the base to the river; (3) The reversal in hydraulic gradient resulting from tidal influences occurs only near the river, generally within 300 feet, and does not seem to significantly alter groundwater flow in other areas of NSB-NLON.

4.6.6.2 Influence of Seasonal Variations on Groundwater Discharge

Seasonal variations of the groundwater table across the site were recorded during monthly groundwater level measurements at monitoring wells. The data were presented in Table 4-10 and discussed in Section 4.6.4.

To initially understand the variation in the 12 months of data, two general statistics were developed. First, a monthly mean groundwater elevation was estimated using each month's entire set of data to determine if there was a general trend in the data by month. The resulting means are summarized in Table 4-10. The means range from 40.73 feet for the month of July to 43.75 feet for the second round of measurements for the month of February. The variations of the monthly water level means generally correlate with the months with lower and higher precipitation and recharge.

The second set of statistics calculated was the standard deviations of the monthly measurements for each individual well. A standard deviation quantifies the departure of monthly groundwater elevations from the mean at each well. The minimum standard deviation (0.227 feet) was calculated for SG-5 at the confluence of Stream 3 and the drainage channel for the Torpedo Shops water level measurements, while the maximum standard deviation (6.802 feet) was determined from water level data for well 2DMW23D (north of Triton Avenue and west of Torpedo Shops). The majority of the standard deviations were approximately 1 foot. The highest standard deviation of water levels occurred in wells which are located along the hillsides and on top of the hills at bedrock high points. Generally, the smallest standard deviations in water levels were noted in wells installed in the valleys, where the overburden thickens and groundwater recharge from upland areas moderates water level variations.

Hydrographs of groundwater elevations versus time were plotted for several wells located along two east-west transects through the site. The transects extend from the head of the northern and southern valleys to locations near the Thames River. Shallow and deep well water levels were plotted independently. The shallow wells for the transect through the northern valley included 2LMW19S, 2LMW7S, 2DMW24S, and 2DMW27S and the deep wells included were 2LMW19D, 2LMW7D, 2DMW24D, and 2DMW27D. The shallow wells for the transect through the southern valley included 15MW3S, OGB-7, ERM-4, 8MW8S, and 8MW6S and the deep wells were 8MW8D and 8MW6D. The resulting hydrographs are presented on Figure 4-1 (shallow wells, northern valley), Figure 4-2 (deep wells, northern valley), Figure 4-3 (shallow wells, southern valley) and Figure 4-4 (deep wells, southern valley).

The hydrographs presented in Figure 4-1 show that in the upgradient areas of the northern valley (2LMW19S and 2LMW7S), the aquifer dewateres during the summer months and tends to recharge during the fall and winter months. The aquifer does not show any real trend of dewatering during the summer months or recharge during the fall and winter months in the portion of the valley closer to the Thames River (2DMW24S and 2DMW27S). This difference in trends can be explained by the storativity of the aquifer material and the hydraulic gradient in the two regions. The upgradient wells are located along the bedrock highs where the overburden is relatively thin. Because the storativity of the bedrock is low and the hydraulic gradient is

relatively steep, the groundwater potentials are more sensitive to seasonal changes. The downgradient wells are located where the bedrock slope is milder and the overburden is thicker. Because the storativity of the overburden is relatively high and the hydraulic gradient is mild, the groundwater potentials are less sensitive to seasonal changes.

The hydrographs for the deep wells (Figure 4-2) show trends similar to those for the corresponding shallow wells (Figure 4-1). One exception between the deep and shallow well hydrographs is the gradient between 2LMW19 and 2LMW7. As shown by the water levels for the shallow wells, there is a consistent northwestern gradient from 2LMW19S to 2LMW7S. The hydraulic head in both deep wells is approximately the same throughout the measurement period.

The hydrographs presented on Figure 4-3 show trends similar to those shown on Figure 4-1 with one exception. The hydrographs for the wells near the Thames River (8MW6S and 8MW8S) show more pronounced tidal effects than the well (2DMW27S) selected from the northern region of the site. The difference is attributable to the proximity of the southern wells to the river. Figure 4-4 displays hydrographs for deep wells at the Goss Cove Landfill. The Goss Cove Landfill wells (8MW8D and 8MW6D) were the only deep wells in the southern valley that were subjected to monthly water level measurements. Figure 4-4 shows that there is a periodic reversal in the gradient between the two wells as a function of time. This trend is most likely a result of tidal variations in the Thames River. Water level variations are greatest for well 8MW6D, which is located nearer the Thames River.

The hydraulic gradients between the shallow wells were also estimated using the monthly data. The hydraulic gradients are presented in Tables 4-11 (northern valley) and 4-12 (southern valley). Variations in the hydraulic gradients are most pronounced along the bedrock highs and least evident in the valleys (with the exception of those attributable to tidal influences).

Based on the evaluation of the monthly water-level data, the following conclusions may be reached regarding seasonal influences on groundwater discharge from NSB-NLON.

- During periods of limited recharge (i.e., summer and early fall), the hydraulic gradients along the bedrock highs (where there is limited overburden thickness) decrease and the groundwater discharge from these areas decreases. Conversely, during periods of significant recharge (late fall and spring), the hydraulic gradients in these areas and groundwater discharge increases.

- Hydraulic gradients in the portions of the site where there is significant overburden (i.e., the valleys and floodplain) remain relatively constant (with the exception of tidal-related variations) throughout the year as does the groundwater discharge.

4.7 DEMOGRAPHY AND LAND USE

This section provides general information regarding demographics. This information has been compiled from the Phase I RI report (Atlantic, August 1992). Several communities are located within 1 mile of NSB-NLON as shown on Drawing 1 (Volume III). According to the U.S. Bureau of the Census, three neighborhoods in the Town of Groton lie adjacent to or within NSB-NLON. The neighborhood boundaries are described as follows:

- North West - The community is located adjacent to NSB-NLON on the east side of Route 12 from the Groton - Ledyard town line to Walker Hill Road on the south. The neighborhood extends west to the Ledyard Reservoir.
- Pleasant Valley - The Pleasant Valley Neighborhood borders the south boundary of NSB-NLON. On the east it is bounded by Connecticut Route 12 and on the west by the Thames River. The southern boundary of Pleasant Valley is Grove Street and Walker Hill Road.
- Naval Submarine Base New London - NSB-NLON as described in Section 1.2.1 is considered a neighborhood in Groton although portions of it are located in Ledyard. Population data reported for this neighborhood are from April 1, 1980.

The Gales Ferry section of Ledyard is also located adjacent to NSB-NLON to the north. Tables 4-13 and 4-14 include 1980 census information for the towns of Groton and Ledyard and shows the total population breakdown by age and sex. More recent data and population information for neighborhoods in the Town of Groton, Town of Ledyard, and for the Gales Ferry section of Ledyard are included where available.

4.8 ECOLOGY

The New London/Groton area lies in the Central Hardwoods zone that covers a large portion of the northeastern United States. Virgin forests in this area have been replaced by second or third growth stands as a result of development. Many wetland areas have been filled to support development. Although the

Thames River has been dredged and its banks have been stabilized, the course of the river is unchanged and the river still supports a variety of indigenous species of flora and fauna.

4.8.1 Terrestrial Habitats

The following descriptions of the NSB-NLON terrestrial habitats was derived primarily from the Initial Assessment Study of Naval Submarine Base, New London, Connecticut, (NEESA, March 1983).

4.8.1.1 Upland Vegetation

Both upland and wetland vegetation are found at NSB-NLON. The climate favors hardwoods over softwoods, although coniferous trees may be prevalent in areas of poor soil where competition from hardwood species is less intense.

Typical of most municipal areas in Connecticut, oak/beech/red maple forests dominate the upland vegetation in this area. These hardwoods, or deciduous trees, comprise most of the total vegetative cover, with oak the dominant species. The softwoods or evergreens account for less than 10 percent of the forest types. White pine, cedar and hemlock are the major trees in this category. Excluding ornamental plantings, evergreens usually occur in nature in concentrated clusters or stands. Both the Pine Swamp and the Great Cedar Swamp in Ledyard are excellent examples of this condition. However, a deciduous tree (red maple) usually dominates along with the evergreens in wet areas.

Although mature hardwoods and softwoods exist in the area, nearly 70 percent of the total woodland is occupied by immature trees as a result of the extensive logging and clearing that took place in the last century and into the present one. Some common understory plants of wooded areas are dogwood, cherry, tupelo, sassafras and other tree saplings, catbriar and grape vine. Poison ivy is also common. Bittersweet, barberry, goldenrod, green briar, catbriar, sumac, hawthorne, grasses and wildflowers flourish in open areas and old pasture land.

4.8.1.2 Fauna

The land within and surrounding NSB-NLON provides habitat for various terrestrial fauna. Common mammals include the eastern grey squirrel, raccoon, white-tailed deer, opossum, eastern cottontail, and woodchuck. Although these species are typically found in hardwood forests and old field habitats, they overlap into the other areas. Common amphibians found in this part of eastern Connecticut include the

American toad, bullfrog, leopard frog, dusky salamander, and the red-backed salamander. Reptiles common to the area include the water snake, garter snake, hognose snake, painted turtle, and spotted turtle.

The avian fauna of the NSB-NLON consists of a variety of species that may be permanently residential, migratory or seasonal. Winter birds often found around home feeders include the tufted titmouse, nuthatch, and cardinal. Summer birds of residential areas are blue jay, robin, chickadee, and house sparrow. Summer birds common to more natural and open areas are mourning dove, common crow, eastern kingbird, and the sparrow hawk. Over 20 species of birds can be found breeding in the upland forests and fields. The most commonly found breeding species are the bobwhite quail, yellow shafted flicker, towhee, and brown thrasher.

4.8.2 Aquatic Habitats

Both freshwater and estuarine aquatic habitats exist at NSB-NLON. Freshwater streams, ponds, lakes and a wetland exist at NSB-NLON. The Thames River, a tidal estuary, borders NSB-NLON on the west. The following sections describe the aquatic habitats in each type of water body.

4.8.2.1 Freshwater

Two lakes, North Lake and Rock Lake, are maintained at NSB-NLON for recreational and aesthetic purposes. North Lake is an artificial (man-made) lake, while Rock Lake is a natural lake.

The other freshwater systems naturally occurring within NSB-NLON are in Area A and they are restricted to shallow waters associated with the wetlands and the ephemeral streams that drain them.

Four wetlands have been delineated in Area A: the Area A Wetland, Upper Pond Wetland, Lower Pond Wetland, and OBDA Wetland. The ephemeral nature of the streams and the shallowness of the wetland surface waters act to restrict the diversity of aquatic fauna within the systems. The following descriptions of these wetland areas were derived primarily from the Wetland Delineation Area A for the NSB-NLON, (Atlantic, July 1994d).

Area A Wetland

The Area A Wetland (23.6 acres) is characterized as a palustrine emergent, nonpersistent, narrow leaved and broad-leaved deciduous scrub/shrub wetland with a nontidal artificial water regime. Areas of open

water (generally shallow) are scattered across this wetland unit. The Area A Wetland was artificially created by depositing dredge spoil from the Thames River into a lowland that contained a small stream. The soft organic sediments that characterize these wetlands support a monoculture of the reed *Phragmites* sp., which dominates all other vegetative forms. There are scattered patches of open water between the stands of reeds; scattered duckweed (*Lemna* spp.) and filamentous algae found in these areas. As the substrates become firmer, the vegetation becomes more typical of vegetation associated with old fields and upland areas. Those found in the zone of transition include viburnum (*Viburnum recognitum*), spicebush (*Lindera benzoin*), and black alder (*Ilex verticillata*).

Upper Pond

The Upper Pond Wetland (0.48 acre) is located approximately 300 feet downstream of the Area A Wetland and is classified as a palustrine open water (shallow) wetland surrounded by a palustrine emergent, nonpersistent, narrow-leaved wetland with an artificial water regime. This wetland has a similar soil regime (aquents) to the Area A Wetland and is characterized by poorly to very poorly drained fine-textured marine sediments transported into this wetland from the upgradient Area A Wetland. The emergent, nonpersistent, narrow-leaved vegetation is dominated by the common reed (*Phragmites* sp.).

Lower Pond

The Lower Pond Wetland (0.50 acre) is located approximately 50 feet west of the Upper Pond Wetland. The Lower Pond is classified as a palustrine open water (shallow) wetland surrounded by a palustrine scrub/shrub and wooded broad-leaved, deciduous wetland with a nontidal seasonal water regime. Sweet pepperbush, highbush blueberry, and red maple dominate the vegetation of this wetland. Wetland soils are classified as native Ridgebury fine sandy loam which are poorly drained, moderately coarse textured, glacial till soil developed over compact till. This wetland is adjacent to a smaller disturbed wetland (0.027 acre) with similar characteristics and dominant vegetation.

OBDA Wetland

The OBDA Wetland (1.29 acres) is located below the dike that forms the Area A Wetland. The OBDA Wetland is approximately 150 feet west of the Area A Wetland and 50 to 250 feet south of the Upper Pond and Lower Pond Wetlands. This wetland is classified as a palustrine emergent, nonpersistent, narrow-leaved wetland surrounded by scrub/shrub and forested broad-leaved deciduous wetland with a nontidal seasonal water regime. The emergent, nonpersistent, narrow-leaved vegetation is dominated by the common reed

(*Phragmites australis*). Sweet pepperbush, highbush blueberry, and red maple are the prevalent shrub and tree vegetation associated with this wetland. Like the Lower Pond Wetland, this wetland's soils are classified as native Ridgebury fine sandy loam which are poorly drained, moderately coarse textured, glacial till soil developed over compact till.

4.8.2.2 Estuarine (Thames River)

Plankton

Very little information exists on the phytoplankton species in the Thames River (ASA, 1989). Most studies have focused on *chlorophyll a* concentrations as a surrogate for phytoplankton densities. *Chlorophyll a* concentrations ranging from 1 to 250 mg/m³ have been reported for the Thames River. In August 1975, *chlorophyll a* ranged from 40 to 90 mg/m³ in the reaches of the river downstream of Montville in both surface and bottom waters. Results of studies in 1974 and 1986 reported lower concentrations ranging from 0 to 41 mg/m³ along the length of river.

Project Oceanology (1989) measured *chlorophyll a* concentrations above and below the pycnocline to assess the contribution of phytoplankton to hypoxic conditions in bottom water of the estuary. The results of the study showed higher *chlorophyll a* concentrations in the surface layer (3 to 15 mg/m³) than in the more saline bottom water (1 to 10 mg/m³).

Phytoplankton/Zooplankton tows were conducted in September, 1972, to determine the density and diversity of phytoplankton in the Thames River. Collection was done with a #25 Standard Mesh Plankton net. Although the exact density was not recorded, the total number of cells was reported to be low. Zooplankton were almost completely absent. The few phytoplankters present were members of the Bacillariophyceae and included *Ditylum brightwelli*, *Coscinodiscus* spp., *Gyrosiama* spp., and *Glenodinium* spp. *Ditylum brightwelli* was the only species which was uniformly present in the samples, although density was very low.

A zooplankton study was performed in the Montville area (approximately 2 miles upstream of NSB-NLON) in spring, summer, and autumn 1987 (ASA, 1989). This study identified adult copepods as the dominant species of zooplankton in the river during that time. In the spring, the dominant species were *Acartia hudsonica*, *Eurytemora hirundoides*, *Temora longicornis*, and *Centropages* sp. In the summer and autumn, *Acartia tonsa* were dominant. Other zooplankton groups included larval forms of barnacles and crabs. In late summer, the presence of a zooplankton predator, the ctenophore *Mnemiopsis leidyi* reduced copepod densities.

A study of ichthyoplankton performed in 1988 and summarized by ASA (1989) identified bay anchovy and winter flounder eggs and larvae, tautog eggs, and rainbow smelt larvae.

A low diatom population was also found in the Thames River. This was probably due to the time of collection. Nutrient levels were not excessively high as thorough mixing had not released nutrients from the bottom sediments. Thus, a dense population of diatoms was not likely. Low temperatures, along with winds and wave action in the fall, will result in a mixing and release of bottom nutrients, subsequently producing a diatom "bloom."

Marine Algae

There were 13 species of algae collected from the Thames River during the 1973 studies (Navy, 1973). These included: 7 Rhodophyta, 2 Phaeophyta and 4 Chlorophyta. The Rhodophyta included: *Chondrus crispus*, *Dosya pedicellata*, *Grinnellia americana*, *Agardhiella tenera*, *Chondria tenuissima*, *Rhodomenia palmata*, and *Gracilaria folifera*. Phaeophyta were: *Laminaria* sp. and *Fucus vesiculosus* var. *sphaerocarpus*. Chlorophyta consisted of: *Codium fragile* ssp. *tomentosoides*, *Ulva lactuca*, *Protoderma marinum* and *Ulthrix flacca*. The majority of the species were collected by dredging and Eckman sampler in the sublittoral zone, while one Scuba dive was also made for collecting purposes. The eulittoral zone is narrow with little substrate for the attachment of algae. Only two species were collected in the eulittoral zone.

The marine algae forms collected were sporadic in distribution. The greatest number of species were collected near the mouth of the river where a total of seven different species were found. *Fucus* sp. and *Ulothrix lacea* were collected at a few locations in the eulittoral zone and from the pier pilings at the NSB-NLON marina. At no station was the density of algae very great.

A 1983 study of macroalgae in the river summarized by ASA (1989) described the non-industrial portions of the Thames River as having a typical northeastern rocky coastline. The macroalgae in these areas consist of *Enteromorpha* sp., *Fucus* sp., *Chondrus* sp., and *Laminaria* sp. with *Ascophyllum* sp. in protected areas in shallow areas reached by light. In the industrial areas, the algal zone was narrow and sparse or dominated by *Ulva* sp., *Cladophora* sp., *Enteromorpha* sp., and *Vaucheria* sp. The depth of the river in the dredged industrial areas and the lack of appropriate substrate preclude the growth of macroalgae there. During sampling conducted in 1993, dense *Ulva* sp. were observed in Mamacoke Cove across the river from the NSB-NLON.

The lack of species diversity and density of algae in the Thames River is probably due to the lack of suitable substrate. Algae growth was largely confined to large *Venus mercenarica* shells and submerged objects such as lobster traps and other debris. Few rocks were present. Small rocks and larger outcroppings were present along one area of the shore where *Fucus sp.* and *Ulothrix sp.* were found.

Marine algae are important in the food chain of Thames River marine organisms. *Laminaria sp.*, *Chondrus sp.*, *Ulva sp.*, and *Rhodomenia sp.* are utilized by such forms as herbivorous gastropods, crustaceans and fishes. These organisms are then eaten by carnivorous forms and so on up the food chain. In addition to being important as a food source, attached marine algae also provide a substrate for the attachment of such invertebrates as hydrozoans, bryozoans, and the polychaete, *Spiroobis sp.* Starfish, polychaetes and molluscs are also found entangled in the holdfasts of *Laminaria sp.* Despite low numbers and diversity, the importance of the algae in the river should not be minimized.

Species of benthic algae found in this area, of which *Ulva sp.* was the most prevalent, are:

- *Agardhiella tenera*
- *Chondria tenuissima*
- *Chondrus crispus*
- *Gracilaria folifera*
- *Grinnellia americana*
- *Protoderma marimum*
- *Ulothrix flacca*
- *Ulva lactuca*
- *Fucus vesiculosus* var. *sphaerocarpus*

One species of vascular plant (*Potamogeton pectinatus*) was found floating throughout the region. No rooted plants of this species were located, however.

Benthic Invertebrates

Historical Data

Much of the existing data on the benthic invertebrates in the Thames River was collected in support of proposed dredging projects. The most comprehensive study was performed for the draft Environmental Impact Statement (EIS) for the Seawolf project (Department of the Navy, 1991). The draft EIS document compared data collected during that survey with previous benthic surveys performed in the Thames River. ASA (1989) also provide a comprehensive summary of benthic data from the Thames River.

Benthic communities in the Thames River differ from south to north and between channel and non-channel areas. Since most of the benthic surveys of the Thames River have been performed in anticipation of dredging, the work has focused on the channel. The benthic communities south of the I-95 bridge (2 miles south of NSB-NLON) are more representative of Long Island Sound. As is expected in an estuary (Maguire Group, 1990), benthic abundance and species richness decreased from the mouth of the river north to NSB-NLON. Species composition is similar north of the I-95 bridge, but abundances are lower, probably due to the shallower, less saline water in this area.

The channel is dominated by several taxa, including the bivalves *Mulinia lateralis* (the opportunistic coot clam) and *Nucula proxima*, and the polychaetes *Nephtys incisa* and *Mediomastus ambiseta*. Welsh and Stewart (1984) also found differences in benthic communities in the channel north and south of the I-95 bridge. North of the bridge, they found that *Nephtys ceaca*, *Potamilla reniformis*, *Pectinaria gouldii*, *Yoldia limatula* predominated. They also found invertebrate species such as the hardshell clam (*Mercenaria mercenaria*), the shrimp (*Crangon septemspinosus*), and a starfish (*Asterias forbesii*). This is similar to what Tolderlund reported in 1975.

In the summer of 1989, Project Oceanology identified *Nucula proxima*, *Yoldia limatula*, *Nephtys incisa*, and *Mulinia lateralis* as the most common and abundant species in areas of the estuary where the sand content of the sediments was less than 40 percent.

Predominant species found by Welsh and Stewart outside the channel in 1984 differed from those found in the channel. Outside the channel they reported the presence of the polychaetes *Scoloplos robustus*, *Pectinaria gouldii*, and *Sabellaria vulgaris*, softshell clams (*Mya arenaria*), hardshell clams, the amphipod *Gammarus oceanis*, the gastropod *Ilyanassa obsoleta*, shrimps *Paleomonetes pugio* and *Crangon septemspinosus*, blue crab (*Callinectes sapidus*), and starfish (*Asteria forbesii*).

Recent Data

The environmental assessment conducted as part of the study for the Pier 17 replacement (Maguire Group Inc., 1994) included the collection of three samples for benthic analysis. One sample was collected from the vicinity of Pier 15 and two samples were collected from the vicinity of Pier 17. These samples were collected in April 1994. Results indicated that the two samples from near Pier 17 had low numbers of benthic invertebrates (15 and 17 individuals) and low numbers of species (five and six) per sample (0.09 m²). The sample from near Pier 15 had 303 individuals per sample and a total of 16 infaunal species. The

polychaete worms *Mediomastus ambiseta* and *Cossura longocirrata* and the bivalves *Mulina lateralis*, *Yoldia limatula*, and *Nucula annulata* were the most common in the samples.

Taxa identified in the Thames River benthic samples collected in November 1993 during studies conducted in support of the Phase II RI included: nemertean, turbellarian, and annelid worms, gastropods, bivalves, crustaceans, and a few species of other phyla. A few species of annelid worms were dominant at most of the Thames River benthic stations. These included *Mediomastus ambiseta*, *Cossura longocirrata*, and *Streblospio benedicti*. *M. ambiseta* accounted for 12 to 55% of individuals at each station. This species has been identified as "opportunistic" (Dauer, 1993.) These are short-lived species that frequently dominate disturbed or distressed habitats. *C. longocirrata* was most notably dominant near shore at the Lower Base and north of Pier 33 where it accounted for 63 and 69% of all individuals, respectively. In contrast, *C. longocirrata* accounted for less than 1% of all individuals on the western shore of the river opposite the DRMO. *S. benedicti* generally accounted for between 5 and 30% of all individuals. Like *M. ambiseta*, *S. benedicti* has been classified as "opportunistic" (Dauer, 1993). Other annelids commonly present but less abundant were *Polycirrus* spp., *Aricidea* (*Acmira*) *catherinae*, *Leitoscoloplos* sp., *Tharyx* sp. A. *Polydora cornuta*, *Clymenalla torquata*, *Hypereteone heteropoda*, *Steptosyllis pettiboneae*, and *Nephtys incisa* and oligochaete worms. The mollusks *Mulinia lateralis*, *Yoldia limatula*, *Tellina agilis*, *Mya arenaria* (softshell clam), and *Nucula annulata* were relatively abundant at some stations. The only crustacean observed at most stations was the amphipod *Ampelisca abdita*.

The mean number of individuals per station in the Phase II RI samples (represented by the mean of the three replicate 0.05 m² samples) ranged from 178 to 1,242. The total number of taxa per station (i.e., the number of taxa observed at a station in at least one of three replicate samples) ranged from 18 to 55.

The benthic invertebrate species identified as dominant or observed during the Phase II RI studies were similar to those reported by others for the Thames River. The results were also similar to those reported for the Pier 15 station (Maguire Group, 1994).

Shellfish

Most of the Thames River is closed to recreational shellfishing due to contamination by fecal bacteria (Citak, 1991). Shellfish beds in a few areas of the Thames River are open to commercial shellfishing on a conditionally restricted basis. Conditional restriction means that shellfish from these areas must be relayed to and held in approved waters for 45 days. Shellfish in these beds are hardshell clams (*Mercenaria*

mercenaria) and oysters (*Crassostrea virginica*). The conditionally restricted shellfish beds are in Waterford and Ledyard waters.

Some commercial lobstering occurs in the river. Most of the commercial lobstering occurs south of the I-95 bridge, over 1.5 miles downstream of NSB-NLON. Recreational fishing for blue crab also occurs in the river. The blue crabs move into the shallower waters of the coves in the summer months. Recreational crabbing usually occurs in July, August, and September (McLeod, 1993). When the water gets colder, blue crabs move into deeper water and south toward Long Island Sound.

Finfish

Abundant fish species in the Thames River include winter flounder, tomcod, and window pane flounder in the deeper channel areas and mummichog and striped killifish near shore.

The Thames River also serves as a feeding area for long range coastal migrants such as menhaden, bluefish, striped bass, and mackerel, and seasonal migrants such as tautog, weakfish, porgy, and whiting. Striped bass also overwinter in the estuarine portion of the Thames River. An important recreational fishery in this area is based on striped bass (Minta, 1992).

Historically, the construction of dams on the Shetucket and Yantic Rivers has limited anadromous fish runs in the Thames River to species who could spawn and survive below these dams (Minta, 1992). Prior to construction of the dams in the 1800's, the river supported many anadromous species including Atlantic salmon and Atlantic sturgeon. Currently, the only anadromous species known to spawn in the vicinity of Norwich are alewife, blueblack herring, and rainbow smelt. A small recreational fishery for American shad exists in the Shetucket River upstream of the Thames River estuary. The CTDEP has a goal to restore the anadromous fishery to the Thames River by encouraging the construction of fish passage facilities on the upstream dams (Minta, 1992).

Birds

Species observed frequently on the river include herring gulls, great black-backed gulls, cormorants, and mute swans. Many duck species, in particular mallards, are observed on the river and overwinter in the coves around Mamacoke Island, opposite the river from NSB-NLON (Askins, 1994). During summer, 10 to 12 mallards and black ducks are normally present in this area; however, during the winter, up to 1,000 ducks have been observed. These include large numbers of canvasback ducks, hooded mergansers, mallards,

black ducks, gadwalls, and redhead ducks. Greater scaup and common goldeneye use the area temporarily.

4.8.3 Endangered Species

Six Federal or State Endangered, Threatened or Special Concerns species have been sighted in the NSB-NLON area (Conn. Dept. of Env. Protection, 1994). The species are summarized on Table 4-15.

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TABLE 4-1
SOUTHEASTERN CONNECTICUT WATER AUTHORITY
POTABLE WATER ANALYTICAL RESULTS (1)
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Parameter (mg/L)	SAMPLE ID/LOCATION(2)							
	1A RSM DIV. Pumphouse Dist.	2A HLC DIV. 26 Hillcrest Dr.	3A TWR DIV. 16 Laurel Leaf	4A BWD DIV. Yard Hydrant #2	5A EST DIV. 270 Ridgewood Dr	6A LNH DIV. 15 Marjorie St.	7A CWD DIV. 41 Chriswood Tr.	8A RBN DIV. 231 Blk. Ash. Swmp
Antimony	0.005U(3)	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Arsenic	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U
Barium	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U
Beryllium	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Cadmium	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Chromium, Total	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Mercury	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U
Nickel	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Selenium	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Silver	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Sodium	23	6	23	5	24	32	10	6
Thallium	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U
Chloride	35	7	31	4	37	20	8	5
Fluoride	0.36	0.12	0.1U	0.13	0.16	0.1U	0.92	0.1U
Sulfate	21	5	11	4	20	5	9	14
Nitrate & Nitrite Nitrogen	1.19	0.45	2.25	0.31	1.32	1.78	0.26	0.11
Nitrite Nitrogen	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Cyanide, Total	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U

- 1 All samples were collected on August 17, 1994
- 2 Sample locations are shown on a figure included in Appendix C.5
- 3 U = Nondetect

TABLE 4-1
SOUTHEASTERN CONNECTICUT WATER AUTHORITY
POTABLE WATER ANALYTICAL RESULTS (1)
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Parameter (mg/L)	SAMPLE ID/LOCATION(2)							
	9A MGN DIV. 103 Park Ave Ext	10A GRF DIV. 81 Spicer Hill	11A LYD DIV. 1 Colby Dr.	12A FVH DIV. 6 Nugget Hill Dr.	13A CHF DIV. 37 Cottonwood Ln.	14A MTV DIV. 32 Florida Dr.	15A NST DIV. 42 Old Colony Dr.	16A BAR DIV. 28 Lake St.
Antimony	0.005U(3)	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Arsenic	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U
Barium	0.02U	0.02U	0.13	0.02U	0.02U	0.02U	0.02U	0.04
Beryllium	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Cadmium	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Chromium, Total	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Mercury	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U
Nickel	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Selenium	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Silver	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Sodium	11	23	10	17	16	13	6	16
Thallium	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U
Chloride	22	24	14	23	26	24	12	43
Fluoride	0.12	0.19	0.66	0.23	0.12	0.1	0.1U	0.11
Sulfate	7	10	2	16	14	12	7	15
Nitrate & Nitrite Nitrogen	3.34	0.74	2.53	2.34	1.22	0.81	0.82	8.76
Nitrite Nitrogen	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Cyanide, Total	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U

- 1 All samples were collected on August 17, 1994
- 2 Sample locations are shown on a figure included in Appendix C.5
- 3 U = Nondetect

TABLE 4-2
SUMMARY OF MANGANESE CONCENTRATIONS - SOIL AND SEDIMENT
NSB-NLON, GROTON, CONNECTICUT

Site/Area	Manganese Concentration Range ⁽¹⁾ (mg/kg)		
	Surface Soil ⁽²⁾	Subsurface Soil ⁽³⁾	Sediment
Background Soils ⁽⁴⁾	63.6 - 188 ⁽⁵⁾	--	--
Connecticut ⁽⁶⁾	~150 - 700	--	--
Eastern U.S. ⁽⁶⁾	2.0U - 7,000	--	--
Reference Waterbodies ⁽⁷⁾	--	--	27.1 - 1240
CBU Drum Storage Area	166 - 228	165 - 290	--
Area A Landfill	93.3 - 285	74 - 1150	--
Area A Wetland	--	142 - 365	55.3 - 376 ⁽⁸⁾
Area A Weapons Center	121 - 257	122 - 390	79.8 - 2640
Downstream Watercourses	255	94.6 - 283	52.9 - 2850
Rubble Fill at Bunker A86	126 - 336	147 - 171	115 - 200
DRMO ⁽⁹⁾	56.7 - 1260	126 - 673	--
Torpedo Shops	87.7 - 367	60.7 - 725	147 - 173
Goss Cove Landfill	145 - 388	123 - 1080	86.2 - 508
Lower Subbase	153	56.1 - 208	--
OBDANE ⁽¹⁰⁾	113 - 330	55.1 - 260	--
SPASDA ⁽¹¹⁾	78 - 327	132 - 214	75.7
Thames River	--	--	99.5 - 466

- 1 Range includes analytical results for soil samples taken during Phase I RI and Phase II RI, if available.
- 2 Surface soil samples were typically taken from 0 to 2 feet.
- 3 Subsurface soil samples were typically taken from > 2 feet.
- 4 Analytical data taken from Background Concentrations of Organics in Soil (Atlantic, April 1995b).
- 5 Analytical data for surface and subsurface soil samples.
- 6 Published data by USGS for the Eastern United States for soils from approximately 20 cm depth (Shacklette and Boerngen, 1984).
- 7 Reference Waterbodies include Pequot Woods Pond, Niantic Pond and Fishtown Brook.
- 8 For the Area A Wetland, sediments and surface soils were combined.
- 9 DRMO - Defense Reutilization and Marketing Office.
- 10 OBDANE - Overbank Disposal Area - Northeast.
- 11 SPASDA - Spent Acid Storage and Disposal Area.

TABLE 4-3

**SUMMARY OF MANGANESE CONCENTRATIONS - GROUNDWATER⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT**

Site/Area	Shallow Wells ⁽²⁾ (µg/L)		Deep Wells ⁽³⁾ (µg/L)	
	Unfiltered	Filtered	Unfiltered	Filtered
Offsite Wells ^(4,5)	--	--	0.7 U ⁽⁶⁾ - 2130	--
CBU Drum Storage Area	409 - 527	406 - 520	--	--
Area A Landfill	126 - 2570	9.1 - 1920	57.5 - 1360	12.1 - 1350
Area A Wetland	648 - 9270	664 - 9360	2.3 - 7160	6.8 - 7090
Area A Weapons Center	2800 - 6500	2820 - 6540	56 - 405	31.1 - 267
Downstream Watercourses	5.6 - 6710	6.5 - 6620	44.2 - 7090	11.1 - 7630
Rubble Fill at Bunker A86	3.1 - 80.1	3.2 - 12.7	33.4	9.3
DRMO ⁽⁷⁾	14.3 - 1010	1.2 - 1130	84.5 - 1440	18.7 - 1460
Torpedo Shops	8.3 - 1760	1.8 - 1780	22.7 - 7830	12.2 - 3530
Goss Cove Landfill	53.8 - 2900	47.6 - 2210	125 - 3250	24.9 - 3380
Lower Subase	3.4 - 2290	0.8 - 1930	--	--
OBDANE ⁽⁸⁾	458 - 770	476 - 779	--	--
SPASDA ⁽⁹⁾	27.4 - 3080	26.9 - 3080	1020 - 1040	991 - 1040

- 1 Range includes analytical results for groundwater samples taken during Phase I RI and Phase II RI, if available.
- 2 Shallow Wells are generally completed/screened in overburden.
- 3 Deep Wells are generally completed/screened in bedrock.
- 4 Analytical data taken from Off-site Residential Well Water Data Evaluation Report (Atlantic, July 1994d).
- 5 Completion depths of some offsite wells are unknown, therefore it was assumed that they were all completed in bedrock.
- 6 U indicates not detected; less than detection limit.
- 7 DRMO - Defense Reutilization and Marketing Office.
- 8 OBDANE - Overbank Disposal Area - Northeast.
- 9 SPASDA - Spent Acid Storage and Disposal Area.

TABLE 4-4
SLUG TEST RESULTS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well - Test Type	Hydraulic Conductivity - K (ft/day - cm/sec)
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BUNKER A-86

4MW2S - Rising Head	3.52 - 1.24E-3
4MW2S - Falling Head	3.17 - 1.12E-3
4MW2S - Mean ⁽²⁾ (Rising and Falling Head)	3.35 - 1.18E-3

DEFENSE REUTILIZATION AND MARKETING OFFICE

6MW7S - Rising Head	1.92 - 6.77E-4
6MW3D - Rising Head	20.3 - 7.16E-3

GOSS COVE

8MW2S - Rising Head	3.93 - 1.39E-3
8MW2D - Rising Head	0.38 - 1.34E-4
8MW2D - Falling Head	0.44 - 1.55E-4
8MW2D - Mean (Rising and Falling Head)	0.41 - 1.45E-4

SPENT ACID STORAGE AND DISPOSAL AREA

15MW1S - Rising Head	6.64 - 2.34E-3
15MW3S - Rising Head	0.07 - 2.47E-5
15MW1S/3S - Geometric Mean ⁽³⁾	0.68 - 2.4E-4

- 1 Hydraulic conductivities determined from slug test data using the Bouwer and Rice Method (Bouwer and Rice, 1976).
- 2 Arithmetic mean.
- 3 The geometric mean was calculated as the square root of the product of the results for wells 15MW1S and 15MW3S.

TABLE 4-5

2LPW1S PUMPING TEST RESULTS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Observation Well	r ⁽²⁾ (ft)	T ⁽³⁾ (ft ² /day)		Ss ⁽⁴⁾	Sy ⁽⁵⁾	Kh - avg ⁽⁶⁾ (ft/day)	Kz - avg ⁽⁷⁾ (ft/day)
2LOW1S	10.5	Early	77.6	0.05	-	-	-
		Late	70.0	-	1.12	3.5	28.1
2LOW2S	24.5	Early	38.3	0.005	-	-	-
		Late	48.6	-	0.24	2.1	4.6

- 1 Calculated using Neuman's method for unconfined aquifers (Neuman, 1975). Calculations are included in Appendix C.2.
- 2 r is the distance from the pumping well to the observation well.
- 3 T is the transmissivity.
- 4 Ss is the specific storage for the early data.
- 5 Sy is the specific yield for the late data.
- 6 Kh is the horizontal hydraulic conductivity.
- 7 Kz is the vertical hydraulic conductivity.

TABLE 4-6

**COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT**

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
PHASE I AND II RI MONITORING WELLS							
1MW2S	88.49	1.08	87.41	9.10	79.39	2.52	85.97
2DMW10D	54.52	8.86	45.66	9.78	44.74	9.49	45.03
2DMW11S	46.85	1.75	45.10	2.37	44.48	2.05	44.80
2DMW11D	53.20	7.36	45.84	8.38	44.82	7.93	45.27
2DMW15D	44.09	4.21	39.88	9.57	34.52	5.87	38.22
2DMW16S	37.85	2.31	35.54	3.40	34.45	2.33	35.52
2DMW16D	37.69	2.13	35.56	3.35	34.34	2.35	35.34
2DMW23D	81.82	17.27	64.55	21.25	60.57	19.02	62.80
2DMW24S	36.29	2.13	34.16	3.46	32.83	2.26	34.03
2DMW24D	34.54	2.55	31.99	3.06	31.48	2.87	31.67
2DMW25S	34.98	5.65	29.33	7.14	27.84	7.05	27.93
2DMW25D	33.46	5.00	28.46	7.27	26.19	6.85	26.61
2DMW26S	28.70	4.76	23.94	5.58	23.12	5.76	22.94
2DMW26D	29.19	8.77	20.42	9.88	19.31	9.52	19.67
2DMW27S	28.17	9.63	18.54	12.00	16.17	WD ⁽⁷⁾	WD
2DMW27D	27.95	17.26	10.69	13.05	14.90	11.73	16.22
2DMW28S	35.26	17.02	18.24	18.45	16.81	17.68	17.58
2DMW28D	35.40	15.31	20.09	16.47	18.93	15.99	19.41

**Revision 1
March 1997**

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
2DMW29S	36.68	8.13	28.55	10.11	26.57	8.60	28.08
2DMW30S	33.11	6.42	26.69	6.95	26.16	6.85	26.26
2LMW7S	84.37	8.71	75.66	11.21	73.16	9.90	74.47
2LMW7D	85.16	4.87	80.29	8.69	76.47	5.50	79.66
2LMW8S	87.45	0.13	87.32	7.00	80.45	0.98	86.47
2LMW8D	89.33	0.00	89.33	1.99	87.34	-1.18 ⁽¹⁾	90.51
2LMW9S	86.96	8.43	78.53	211.96	75.00	9.67	77.29
2LMW9D	87.11	26.07	61.04	30.03	57.08	27.32	59.79
2LMW13S	88.53	12.96	75.57	16.13	72.40	13.76	74.77
2LMW13D	88.20	2.68	85.52	10.16	78.04	4.15	84.05
2LMW14D	93.90	4.32	89.58	12.59	81.31	5.33	88.57
2LMW17S	82.12	6.05	76.07	7.47	74.65	6.57	75.55
2LMW17D	82.37	0.00	82.37	1.05	81.32	-0.51 ⁽¹⁾	82.88
2LMW18S	77.60	4.95	72.65	6.37	71.23	5.84	71.76
2LMW18D	77.34	5.68	71.66	9.32	68.02	7.49	69.85
2LMW19S	93.50	8.76	84.74	15.88	77.62	12.56	80.94
2LMW19D	93.90	8.78	85.12	16.03	77.87	12.22	81.68
2LMW20S	87.35	14.37	72.98	16.07	71.28	15.46	71.89
2LMW20D	87.55	7.79	79.76	10.35	77.20	9.65	77.90
2LOW1S	88.40	9.79	78.61	11.27	77.13	10.27	78.13
2LOW1D	89.26 ⁽²⁾	5.89	83.54	9.85	79.58	6.43	82.83

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
2LOW2S	89.09	10.45	78.64	11.42	77.67	11.11	77.98
2LOW3S	87.47 ⁽²⁾	9.43	78.09	11.95	75.57	11.86	75.61
2LOW4S	89.36	9.33	80.03	10.57	78.79	9.57	79.79
2LPW1S	89.07	10.52	78.55	11.97	77.10	11.26	77.81
2WCMW1S	83.92	10.61	73.31	12.82	71.10	10.81	73.11
2WCMW2S	86.16	2.45	83.71	6.04	80.12	3.64	82.52
2WCMW3S	85.95	8.51	77.44	10.79	75.16	9.19	76.76
2WMW1D	127.58	UL ⁽⁸⁾	UL	UL	UL	UL	UL
2WMW2D	110.22	UL	UL	30.26	79.96	27.81	82.41
2WMW3S	81.04	6.57	74.47	6.83	74.21	7.31	73.73
2WMW3D	81.36	4.82	76.54	6.13	75.23	5.41	75.95
2WMW4D	92.69	7.05	85.64	9.57	83.12	7.38	85.31
2WMW5S	76.48	2.96	73.52	3.95	72.53	4.08	72.40
2WMW5D	75.96	1.71	74.25	3.28	72.68	2.85	73.11
2WMW6S	84.67	7.14	77.53	DRY ⁽⁹⁾	DRY	9.97	74.70
2WMW6D	84.87	8.39	76.48	15.37	69.50	11.41	73.46
2WMW21S	76.47	4.08	72.39	4.15	72.32	4.73	71.74
2WMW21D	74.79	2.35	72.44	3.07	71.72	3.61	71.18
2WMW22D	121.62	17.09	104.53	24.64	96.98	19.49	102.13
3MW12D	42.20	0.00	42.20	0.52	41.68	5.00	37.20
3MW12S	43.51	2.52	40.99	2.62	40.89	2.46	41.05

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
4MW1S	129.51	NA ⁽¹⁰⁾	NA	6.36	123.15	6.60	122.91
4MW2S	98.79	1.95	96.84	5.12	93.67	3.30	95.49
4MW3S	103.49	3.39	100.10	6.15	97.34	4.99	98.50
4MW4S	110.33	0.57	109.76	0.40	109.93	-1.27 ⁽¹⁾	111.60
4MW4D	109.74	0.00	109.74	0.00	109.74	-2.19 ⁽¹⁾	111.93
6MW1S	8.63	7.02	1.61	6.23	2.40	4.92	3.71
6MW2S	7.30	5.79	1.51	4.91	2.39	3.69	3.61
6MW2D	7.85	4.90	2.95	5.05	2.80	4.52	3.33
6MW3S	6.10	4.45	1.65	3.62	2.48	1.49	4.61
6MW3D	4.78	4.15	0.63	1.88	2.90	1.65	3.13
6MW5S	13.88	10.45	3.43	10.84	3.04	10.97	2.91
6MW5D	13.93	10.39	3.54	10.93	3.00	10.94	2.99
6MW6S	12.16	8.43	3.73	8.90	3.26	8.30	3.86
6MW6D	10.02	8.70	1.32	9.15	0.87	8.63	1.39
6MW7S	5.49	3.86	1.63	3.70	1.79	2.20	3.29
6MW8S	5.44	2.45	2.99	2.45	2.99	2.90	2.54
7MW1D	54.08	8.36	45.72	9.24	44.84	9.35	44.73
7MW2S	50.41	NA	NA	8.24	42.17	6.21	44.20
7MW2D	43.02	3.45	39.57	4.51	38.51	4.06	38.96
7MW3S	45.71	5.24	40.47	5.48	40.23	6.07	39.64
7MW3D	46.67	7.50	39.17	8.35	38.32	8.16	38.51

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
7MW4S	46.84	1.83	45.01	2.23	44.61	2.25	44.59
7MW5S	56.62	11.73	44.89	12.07	44.55	12.09	44.53
7MW5D	56.57	35.39	21.18	17.27	39.30	12.17	44.40
7MW6S	46.64	3.66	42.99	3.77	42.88	4.07	42.57
7MW7S	46.57	1.64	44.93	2.02	44.55	2.02	44.55
7MW8S	42.10	2.69	39.41	4.07	38.03	3.89	38.21
7MW9S	37.91	3.45	34.46	6.09	31.82	4.66	33.25
7MW10S	43.42	10.31	33.11	12.63	30.79	11.39	32.03
7MW11S	46.49	3.58	42.91	3.77	42.72	3.91	42.58
8MW1	10.15	8.69	1.46	9.80	0.35	6.02	4.13
8MW2S	9.43	6.59	2.84	6.65	2.78	6.09	3.34
8MW2D	9.77	7.09	2.68	7.48	2.29	5.00	4.77
8MW3	8.96	5.70	3.26	5.92	3.04	5.83	3.13
8MW4	9.34	5.77	3.57	6.09	3.25	6.20	3.14
8MW5S	10.94	9.94	1.00	9.86	1.08	6.73	4.21
8MW6S	9.66	6.19	3.47	6.45	3.21	6.46	3.20
8MW6D	9.62	6.36	3.26	7.11	2.51	4.75	4.87
8MW7S	10.45	6.33	4.12	6.75	3.70	7.02	3.43
8MW8S	19.68	14.14	5.54	15.55	4.13	15.33	4.35
8MW8D	19.53	15.51	4.02	16.48	3.05	15.22	4.31
13MW1	13.36	9.50	3.86	10.21	3.15	10.05	3.31

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
13MW2	12.80	8.92	3.88	9.64	3.16	9.44	3.36
13MW3	12.89	9.03	3.86	9.79	3.10	9.57	3.32
13MW5	11.13	UL	UL	UL	UL	UL	UL
13MW6	21.47	18.54	2.93	18.66	2.81	18.45	3.02
13MW8	7.34	4.43	2.91	5.72	1.62	5.73	1.61
13MW9	6.91	4.00	2.91	3.52	3.39	5.97	0.94
13MW10	8.44	5.93	2.51	5.95	2.49	5.82	2.62
13MW11	7.83	5.42	2.41	4.90	2.93	5.18	2.65
13MW12	9.21	5.93	3.28	6.16	3.05	6.23	2.98
13MW13	8.50	5.22	3.28	5.40	3.10	5.39	3.11
13MW14	7.98	4.98	3.00	5.52	2.46	6.18	1.80
13MW15	7.25	4.55	2.70	4.75	2.50	6.23	1.02
13MW16	7.30	4.60	2.70	4.71	2.59	6.19	1.11
13MW17	7.47	4.75	2.72	5.77	1.70	6.12	1.35
13MW18	12.12	8.18	3.94	8.94	3.18	NA	NA
13MW19	8.05	4.15	3.90	4.71	3.34	4.34	3.71
13MW20	10.45	6.55	3.90	7.31	3.14	7.10	3.35
13MW21	8.70	4.85	3.85	5.50	3.20	5.22	3.48
14MW1S	51.44	2.83	48.61	4.99	46.45	3.48	47.96
15MW1S	28.08	2.46	25.62	6.69	21.39	6.92	21.16
15MW1D	28.05	6.18	21.87	9.51	18.54	9.40	18.65

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
15MW2S	28.90	3.00	25.90	7.27	21.63	7.65	21.25
15MW3S	26.26	NA	NA	5.23	21.03	5.34	20.92
15MW4S	26.24	1.10	25.14	4.68	21.56	5.13	21.11
19MW2	6.98	UL	UL	4.05	2.93	4.80	2.18
19MW3	6.89	UL	UL	UL	UL	4.22	2.67
19MW4	7.09	UL	UL	4.05	3.04	UL	UL
20MW2	7.74	UL	UL	4.84	2.90	5.27	2.47
20MW3	6.66	UL	UL	4.19	2.47	4.46	2.20
20MW4	8.09	UL	UL	5.10	2.99	5.17	2.92
20MW5	6.46	UL	UL	3.50	2.96	3.32	3.14
20MW6	10.02	UL	UL	6.83	3.19	6.53	3.49
20MW7	5.96	UL	UL	2.75	3.21	2.86	3.10

FFS WELLS AND PIEZOMETERS

2LMW28F	87.43	NI ⁽¹¹⁾	NI	NI	NI	10.92	76.51
2LMW28DS	87.41	NI	NI	NI	NI	18.17	69.24
2LMW29F	90.30	NI	NI	NI	NI	8.55	81.75
2LMW29DS	90.96	NI	NI	NI	NI	7.80	83.16
2LMW30F	80.79	NI	NI	NI	NI	9.23	71.56
2LMW30DS	80.32	NI	NI	NI	NI	18.19 ⁽³⁾	62.13 ⁽³⁾
2LMW31F	86.64	NI	NI	NI	NI	2.81	83.83
2LMW31DS	88.16	NI	NI	NI	NI	2.01	86.15

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
2LMW32PZ	82.11	NI	NI	NI	NI	10.49	71.62
2LMW32F	82.95	NI	NI	NI	NI	11.29	71.66
2LMW32DS	82.69	NI	NI	NI	NI	11.10	71.59
2LMW32B	82.74	NI	NI	NI	NI	8.66	74.08
2LMW33F	82.86	NI	NI	NI	NI	DRY	DRY
2LMW33DS	82.87	NI	NI	NI	NI	12.58	70.29
2LMW34DS	77.05	NI	NI	NI	NI	19.20	57.85
2LMW35B	199.14	NI	NI	NI	NI	17.47	181.67
2LMW36B	213.04	NI	NI	NI	NI	12.85	200.19
2LPZ1DS	74.23	NI	NI	NI	NI	4.34	69.89
2LPZ2DS	76.74	NI	NI	NI	NI	5.23	71.51
2LPZ3DS	73.98	NI	NI	NI	NI	2.41	71.57
2LPZ4DS	74.29	NI	NI	NI	NI	2.72	71.57
2LPZ5DS	75.08	NI	NI	NI	NI	3.50	71.58
2LPZ6DS	74.83	NI	NI	NI	NI	3.27	71.56
2LPZ7DS	78.78	NI	NI	NI	NI	5.51	73.27
2LPZ1F	79.30	NI	NI	NI	NI	7.74	71.56
2LPZ2F	91.10	NI	NI	NI	NI	4.24	86.86

TABLE 4-6 (Continued)
 COMPREHENSIVE WATER LEVEL MEASUREMENTS
 NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
PRE-RI/RESIDENTIAL WELLS							
ERM-4	21.90	3.62	18.28	4.25	17.65	WD	WD
MW-6	21.89	WF ⁽¹²⁾	WF	WF	WF	WF	WF
NESO-4	8.22	5.99	2.23	6.42	1.80	5.96	2.26
NESO-6	8.67	6.22	2.45	6.14	2.53	5.97	2.70
NESO-10	8.10	6.21	1.89	6.20	1.90	NA	NA
NESO-11	8.78	5.30	3.48	5.45	3.33	5.39	3.39
OBG-7	25.15	5.47	19.68	6.85	18.30	NA	NA
OSW2	67.62	NM ⁽¹³⁾	NM	NM	NM	9.61	58.01
OSW3	47.08	NM	NM	NM	NM	21.61	25.47
OSW5	55.80	NM	NM	NM	NM	5.38	50.42
OSW8	82.43	NM	NM	NM	NM	4.85	77.58
OSW8A	78.63	NM	NM	NM	NM	3.00	75.63
OSW10	12.96	NM	NM	NM	NM	10.81	2.15
OSW11	23.15	NM	NM	NM	NM	0.92	22.23
OSW12	139.63	7.84	131.79	20.09	119.54	18.96	120.67
OSW14	53.52	NM	NM	NM	NM	14.78	38.74
OSW23	140.11	NM	NM	NM	NM	13.52	126.59
OT-MW01	25.11	3.81	21.30	7.33	17.78	WD	WD
OT-MW02	25.71	3.15	22.56	7.94	17.77	WD	WD
OT-MW03	25.35	3.96	21.39	7.58	17.77	WD	WD

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
OT-MW04	25.97	4.26	21.71	8.20	17.77	WD	WD
WE-1	9.42	6.14	3.28	6.31	3.11	6.33	3.09
WE-4	8.61	5.53	3.08	WF	WF	5.59	3.02
WE-5	8.25	5.71	2.54	5.29	2.96	5.72	2.53

STAFF GAUGES

SG-1	8.84	6.51	2.33	7.35 ⁽⁴⁾	1.49	5.52	3.32
SG-2	7.20	4.62	2.58	5.44	1.76	---	---
SG-3	26.58 ⁽⁵⁾	4.90	21.68	DRY	DRY	WD	WD
SG-4	32.10	5.22	26.88	4.13	27.97	5.05	27.05
SG-5	41.42	2.35	39.07	2.57	38.85	2.66	38.76
SG-6	85.29	14.81	70.48	15.45	69.84	14.95	70.34
SG-7	75.78	NI	NI	NI	NI	DRY	DRY
SG-8	77.16	NI	NI	NI	NI	DRY	DRY
SG-9	75.37	NI	NI	NI	NI	4.26	71.11
SG-10	75.11	NI	NI	NI	NI	3.58	71.53
SG-11	74.73	NI	NI	NI	NI	3.29	71.44
SG-12	74.51	NI	NI	NI	NI	2.91	71.60
SG-13	75.07	NI	NI	NI	NI	3.45	71.62
SG-14	77.66	NI	NI	NI	NI	DRY	DRY

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
TANK FARM/BALLFIELD RI WELLS							
ERM-1	20.10	NM	NM	NM	NM	5.25	14.85
ERM-2	19.64	NM	NM	NM	NM	4.51	15.13
ERM-5	NM	NM	NM	NM	NM	NM	NM
ERM-11	20.51	NM	NM	NM	NM	6.12	14.39
ERM-13	23.13	NM	NM	NM	NM	7.91	15.22
ERM-14	22.82	NM	NM	NM	NM	7.71	15.11
ERM-15	20.24	NM	NM	NM	NM	4.90	15.34
ERM-17	19.76	NM	NM	NM	NM	5.78	13.98
ERM-19	19.64	NM	NM	NM	NM	5.69	13.95
HNUS-1	19.46	NI	NI	NI	NI	4.87'	14.59
HNUS-2	18.31	NI	NI	NI	NI	4.67	13.64
HNUS-4	18.85	NI	NI	NI	NI	5.07	13.78
HNUS-5	18.96	NI	NI	NI	NI	5.33	13.63
HNUS-6	19.70	NI	NI	NI	NI	5.38	14.32
HNUS-7	20.23	NI	NI	NI	NI	7.98	12.25
HNUS-8	20.30	NI	NI	NI	NI	5.40	14.90
HNUS-9	19.65	NI	NI	NI	NI	4.95	14.70
HNUS-10	20.86	NI	NI	NI	NI	8.55	12.31
HNUS-11	19.84	NI	NI	NI	NI	7.92	11.92
HNUS-12	24.08	NI	NI	NI	NI	4.02	20.06

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

Well or Staff Gauge	Reference Elevation (ft msl)	March 30, 1994		August 23-24, 1994		November 20, 1995	
		Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)	Depth to Water (ft)	Elevation (ft msl)
HNUS-13	23.32	NI	NI	NI	NI	4.68	18.64
HNUS-14	20.57	NI	NI	NI	NI	4.83	15.74
HNUS-15	20.74	NI	NI	NI	NI	5.10	15.64
HNUS-16	18.70	NI	NI	NI	NI	4.70	14.00
HNUS-17	19.69	NI	NI	NI	NI	3.73	15.96
HNUS-18	19.84	NI	NI	NI	NI	4.57	15.27
HNUS-20	20.21	NI	NI	NI	NI	7.22	12.99
HNUS-21	19.95	NI	NI	NI	NI	7.09	12.86
HNUS-22	25.31	NI	NI	NI	NI	11.90	13.41
HNUS-23	18.03	NI	NI	NI	NI	6.50	11.53
HNUS-24	24.72	NI	NI	NI	NI	10.74	13.98
MW-7	19.12	NI	NI	NI	NI	5.51 ⁽⁶⁾	13.61
MW-11	25.23	NI	NI	NI	NI	5.00	20.23

- 1 Flowing Artesian well. Water level above ground surface. Negative depth to water number indicates water level height above top of well casing.
- 2 Well reconstructed prior to November 1995 round of water levels. Previous reference elevations were 89.43' (2LOW1D) and 87.52' (2LOW3S).
- 3 Well had not recovered from purging at time of measurement.
- 4 Elevation during August measurement round to sediment bed (low tide).
- 5 This staff gauge is installed in a concrete tank at site OT-5. This site is not part of the Phase I and Phase II RI but was used as a measuring point to support the basewide water level measurement program.
- 6 Product in well.
- 7 WD - Well destroyed. Water level measurements could not be obtained.
- 8 UL - Unable to locate.
- 9 DRY - Well was dry.
- 10 NA - Not accessible.

TABLE 4-6 (Continued)
COMPREHENSIVE WATER LEVEL MEASUREMENTS
NSB-NLON, GROTON, CONNECTICUT

11	NI	-	Not installed on date of measurement.
13	NM	-	Not measured.
12	WF	-	Well filled with soil (MW-6 and WE-4).

Note: Water Levels could not be obtained from the following offsite wells during the November 1995 sampling round:
OSW28 and OSW29 - Destroyed
OSW6 - Nailed Shut
OSW21, OSW22, and OSW25-Buried
OSW32 - Owner not home

Wells 6MW4S, 13MW4, 13MW7, OSW28, OSW29, and WE-4A were destroyed prior to the March 30, 1994 round of water levels, and are therefore not included on this table.

TABLE 4-7
COMPARISON OF HYDRAULIC GRADIENTS IN BEDROCK
NSB-NLON, GROTON, CONNECTICUT

Location	Well Transect	Distance (ft)	Bedrock Slope	Hydraulic ⁽¹⁾ Gradient
Rubble Fill at Bunker A-86	4MW1S/4MW2S	135	0.258	0.218
Area A Landfill/OBDA	2LMW13D/3MW12D	300	0.137	0.124
Area A Downstream Watercourses (North Lake)	2DMW16D/2DMW24D	90	0.048	0.032
Area A Downstream Watercourses (Golf Course)	2DMW25D/2DMW28D	420	0.022	0.017

1 Calculated using August 23-24, 1994 water levels.

TABLE 4-8
COMPARISON OF HYDRAULIC GRADIENTS IN OVERBURDEN
NSB-NLON, GROTON, CONNECTICUT

Location	Well Transect	Distance (ft)	Hydraulic ⁽¹⁾ Gradient
Area A Weapons Center	2WCMW2S/2WCMW3S	345	0.014
Area A Weapons Center	2WCMW2S/2WCMW1S	540	0.017
Area A Downstream Watercourses (Golf Course)	2DMW25S/2DMW28S	420	0.026
Area A Downstream Watercourses/Lower Subase	2DMW27S/19MW4	405	0.032

1 Calculated using August 23-24, 1994 water levels.

TABLE 4-9

**VERTICAL GRADIENTS AT SELECT WELL CLUSTER LOCATIONS
NSB-NLON, GROTON, CONNECTICUT**

WELL CLUSTER	LOCATION	ELEVATION DIFFERENCE BETWEEN MONITORED INTERVALS (X)	MARCH 30, 1994			AUGUST 23-24, 1994			NOVEMBER 20, 1995		
			HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y1)	VERTICAL GRADIENT (Y1/X)	GRADIENT DIRECTION	HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y2)	VERTICAL GRADIENT (Y2/X)	GRADIENT DIRECTION	HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y3)	VERTICAL GRADIENT (Y3/X)	GRADIENT DIRECTION
2DMW16S/D	Downstream Watercourses Adjacent to Stream 1	31.96	(0.02)	(0.00063)	UPWARD	0.11	0.00344	DOWNWARD	0.18	0.00563	DOWNWARD
2DMW24S/D	Downstream Watercourses Adjacent to North Lake	26.16	2.17	0.08295	DOWNWARD	1.35	0.05161	DOWNWARD	2.36	0.09021	DOWNWARD
2DMW25S/D	Downstream Watercourses Adjacent to Stream 6	21.02	0.87	0.04139	DOWNWARD	1.65	0.07850	DOWNWARD	1.32	0.06280	DOWNWARD
2DMW26S/D	Downstream Watercourses on Golf Course	21.52	3.52	0.16357	DOWNWARD	3.81	0.17704	DOWNWARD	3.27	0.15195	DOWNWARD
2DMW27S/D	Downstream Watercourses on Golf course	98.22	(1.85)	(0.01884)	UPWARD	(2.12)	(0.02158)	UPWARD	(1.83)	(0.01863)	UPWARD
2DMW28S/D	Downstream Watercourses on Golf Course	61.43	7.85	0.12779	DOWNWARD	1.27	0.02067	DOWNWARD	WD	WD	WD
2LMW7S/D	Central Portion of Landfill Near Wetland	21.59	(4.63)	(0.21445)	UPWARD	(3.31)	(0.15331)	UPWARD	(5.19)	(0.24039)	UPWARD
2LMW8S/D	Central Portion of Landfill Near CBU Drum Storage Area and Bedrock High	74.25	(2.01)	(0.02707)	UPWARD	(6.89)	(0.09279)	UPWARD	(4.04)	(0.05441)	UPWARD
2LMW9S/D	Western Edge of Landfill Near Dike	40.03	17.49	0.43692	DOWNWARD	17.92	0.44766	DOWNWARD	17.50	0.43717	DOWNWARD
2LMW13S/D	Western Edge of Landfill Near Dike	30.9	(9.95)	(0.32195)	UPWARD	(5.64)	(0.18249)	UPWARD	(9.28)	(0.30028)	UPWARD
2LMW17S/D	Central Portion of Landfill in Deployed Parking	17.66	(6.30)	(0.35674)	UPWARD	(6.67)	(0.37769)	UPWARD	(7.33)	(0.41506)	UPWARD

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TABLE 4-9

**VERTICAL GRADIENTS AT SELECT WELL CLUSTER LOCATIONS
NSB-NLON, GROTON, CONNECTICUT**

WELL CLUSTER	LOCATION	ELEVATION DIFFERENCE BETWEEN MONITORED INTERVALS (X)	MARCH 30, 1994			AUGUST 23-24, 1994			NOVEMBER 20, 1995		
			HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y1)	VERTICAL GRADIENT (Y1/X)	GRADIENT DIRECTION	HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y2)	VERTICAL GRADIENT (Y2/X)	GRADIENT DIRECTION	HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y3)	VERTICAL GRADIENT (Y3/X)	GRADIENT DIRECTION
2LMW18S/D	East Central Portion of Landfill Near Access Road	34.54	0.99	0.02866	DOWNWARD	3.21	0.09294	DOWNWARD	1.91	0.05530	DOWNWARD
2LMW19S/D	Parking Lot East of Landfill Near Small Hillside	53.60	(0.38)	(0.00709)	UPWARD	(0.25)	(0.00466)	UPWARD	(0.74)	(0.01381)	UPWARD
2LMW20S/D	Parking Lot East of Landfill at Bottom of Large Hill	62.80	(6.78)	(0.10796)	UPWARD	(5.92)	(0.09427)	UPWARD	(6.01)	(0.09570)	UPWARD
2WMW5S/D	Interior of Wetland	14.27	(0.73)	(0.05116)	UPWARD	(0.15)	(0.01051)	UPWARD	(0.71)	(0.04975)	UPWARD
2WMW6S/D	Western Edge of Weapons Center Near Dike	24.17	1.05	0.04344	DOWNWARD	DRY	DRY	DRY	1.24	0.05130	DOWNWARD
3MW12S/D	OBDA Near Stream 1	15.61	(1.21)	(0.07751)	UPWARD	(0.79)	(0.05061)	UPWARD	3.85	0.24664	DOWNWARD
4MW4S/D	Rubble Fill Area on Slope of Steep Hill	26.01	0.02	0.00077	DOWNWARD	0.19	0.00730	DOWNWARD	(0.33)	(0.01269)	UPWARD
6MW2S/D	DRMO Along Thames River	72.56	(1.44)	(0.01985)	UPWARD	(0.41)	(0.00565)	UPWARD	0.28	0.00386	DOWNWARD
6MW3S/D	DRMO Along Thames River	73.60	1.05	0.01427	DOWNWARD	(0.42)	(0.00571)	UPWARD	1.48	0.02011	DOWNWARD
6MW5S/D	East of DRMO Along Hillside	20.02	(0.11)	(0.00549)	UPWARD	0.04	0.00200	DOWNWARD	(0.08)	(0.00400)	UPWARD
6MW6S/D	East of DRMO Along Barb Road Near Bedrock Outcrop	23.99	2.41	0.10046	DOWNWARD	2.39	0.09962	DOWNWARD	2.47	0.10296	DOWNWARD
7MW5S/D	North Side of Torpedo Shops Near Hillside	25.10	23.71	0.94462	DOWNWARD	5.25	0.20916	DOWNWARD	0.13	0.00518	DOWNWARD
8MW2S/D	Central Portion of Goss Cove Landfill Near Thames River	47.84	0.16	0.00334	DOWNWARD	0.49	0.01024	DOWNWARD	(1.43)	(0.02989)	UPWARD

TABLE 4-9

**VERTICAL GRADIENTS AT SELECT WELL CLUSTER LOCATIONS
NSB-NLON, GROTON, CONNECTICUT**

WELL CLUSTER	LOCATION	ELEVATION DIFFERENCE BETWEEN MONITORED INTERVALS (X)	MARCH 30, 1994			AUGUST 23-24, 1994			NOVEMBER 20, 1995		
			HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y1)	VERTICAL GRADIENT (Y1/X)	GRADIENT DIRECTION	HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y2)	VERTICAL GRADIENT (Y2/X)	GRADIENT DIRECTION	HEAD DIFFERENCE BETWEEN WATER LEVEL ELEVATIONS (Y3)	VERTICAL GRADIENT (Y3/X)	GRADIENT DIRECTION
8MW6S/D	South Portion of Goss Cove Landfill Near Museum	56.20	0.21	0.00374	DOWNWARD	0.70	0.01246	DOWNWARD	(1.67)	(0.02972)	UPWARD
8MW8S/D	Upgradient of Goss Cove Landfill Near Bedrock Outcrop	51.18	1.52	0.02970	DOWNWARD	1.08	0.02110	DOWNWARD	0.04	0.00078	DOWNWARD
15MW1S/D	Spent Acid Storage and Disposal Area	31.10	3.75	0.12058	DOWNWARD	2.85	0.09164	DOWNWARD	2.51	0.08071	DOWNWARD

WD - Well destroyed

DRY - Well was dry

NA - Not accessible

TABLE 4-10
MONTHLY WATER LEVELS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well Number	Reference Elevation (feet msl)	March 30, 1994		May 3, 1994		May 26, 1994 ⁽²⁾		June 29, 1994		July 26, 1994		August 23-24, 1994 ⁽³⁾	
		Day 89		Day 123		Day 146		Day 180		Day 207		Day 235	
		DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation
2DMW16S	37.85	2.31	35.54	6.51	31.34	4.27	33.58	5.02	32.83	5.64	32.21	3.40	34.45
2DMW16D	37.69	2.13	35.56	6.48	31.21	4.00	33.69	4.86	32.83	5.27	32.42	3.35	34.34
2DMW23D	81.82	17.27	64.55	19.83	61.99	23.58	58.24	31.10	50.72	35.19	46.63	21.25	60.57
2DMW24S	36.29	2.13	34.16	6.51	29.78	3.25	33.04	3.63	32.66	3.89	32.40	3.46	32.83
2DMW24D	34.54	2.55	31.99	8.72	25.82	3.42	31.12	3.63	30.91	3.82	30.72	3.06	31.48
2DMW25S	34.98	5.65	29.33	8.05	26.93	7.79	27.19	8.23	26.75	8.50	26.48	7.14	27.84
2DMW25D	33.46	5.00	28.46	8.38	25.08	7.94	25.52	8.60	24.86	8.84	24.62	7.27	26.19
2DMW27S	28.17	9.63	18.54	12.26	15.91	12.20	15.97	12.70	15.47	12.83	15.34	12.00	16.17
2DMW27D	27.95	17.26	10.69	11.64	16.31	12.86	15.09	⁽⁴⁾	NA ⁽⁷⁾	13.85	14.10	13.05	14.90
2LMW7S	84.37	8.71	75.66	10.47	73.90	10.82	73.55	11.56	72.81	12.31	72.06	11.21	73.16
2LMW7D	85.16	4.87	80.29	6.28	78.88	6.51	78.65	8.11	77.05	10.20	74.96	8.69	76.47
2WMW22D	121.62	17.09	104.53	17.67	103.95	18.97	102.65	21.64	99.98	24.14	97.48	24.64	96.98
3MW12D	42.20	0.00	42.20	0.90	41.30	0.65	41.55	0.96	41.24	1.40	40.80	0.52	41.68
3MW12S	43.51	2.52	40.99	2.65	40.86	2.82	40.69	2.69	40.82	3.22	40.29	2.62	40.89
7MW3S	45.71	5.24	40.47	5.84	39.87	6.44	39.27	7.01	38.70	7.27	38.44	5.48	40.23
7MW3D	46.67	7.50	39.17	8.49	38.18	8.90	37.77	9.65	37.02	10.28	36.39	8.35	38.32
19MW4	7.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.05	3.04
SG-4	32.10	5.22	26.88	5.56	26.54	5.49	26.61	5.65	26.45	5.82 ⁽⁵⁾	NA	4.13	27.97
SG-5	41.42	2.35	39.07	2.71	38.71	2.48	38.94	2.69	38.73	3.71 ⁽⁵⁾	NA	2.57	38.85
SG-6	85.29	14.81	70.48	14.97	70.32	14.86	70.43	15.37	69.92	15.79	69.50	15.45	69.84

TABLE 4-10 (Continued)
MONTHLY WATER LEVELS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well Number	Reference Elevation (foot msl)	March 30, 1994		May 3, 1994		May 26, 1994 ⁽²⁾		June 29, 1994		July 26, 1994		August 23-24, 1994 ⁽²⁾	
		Day 89		Day 123		Day 146		Day 180		Day 207		Day 235	
		DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation
8MW6S	9.66	6.19	3.47	7.13	2.53	6.52	3.14	6.88	2.78	6.85	2.81	6.45	3.21
8MW6D	9.62	6.36	3.26	7.07	2.55	5.52	4.10	8.00	1.62	5.85	3.77	7.11	2.51
8MW8S	19.68	14.14	5.54	15.43	4.25	15.58	4.10	15.30	4.38	15.25	4.43	15.55	4.13
8MW8D	19.53	15.51	4.02	16.48	3.05	15.78	3.75	16.92	2.61	15.95	3.58	16.48	3.05
15MW3S	26.26	NA	NA	3.13	23.13	3.46	22.80	4.42	21.84	5.50	20.76	5.23	21.03
ERM-4	21.90	3.62	18.28	4.37	17.53	4.05	17.85	4.54	17.36	4.81	17.09	4.25	17.65
OBG-7	25.15	5.47	19.68	5.91	19.24	6.00	19.15	6.42	18.73	6.66	18.49	6.85	18.30
13MW1	13.36	9.50	3.86	10.08	3.28	10.15	3.21	10.42	2.94	10.55	2.81	10.21	3.15
13MW8	7.34	4.43	2.91	5.87	1.47	3.96	3.38	5.83	1.51	3.89	3.45	5.72	1.62
13MW18	12.12	8.18	3.94	8.76	3.36	8.73	3.39	9.14	2.98	9.20	2.92	8.94	3.18
6MW3S	6.10	4.45	1.65	4.87	1.23	3.96	2.14	4.86	1.24	2.45	3.65	3.62	2.48
6MW3D	4.78	4.15	0.63	5.28	1.0	NA	NA	2.74	NA	1.90	NA	1.88	NA
6MW5S	13.88	10.45	3.43	11.62	2.26	11.00	2.88	11.51	2.37	11.54	2.34	10.84	3.04
6MW5D	13.93	10.39	3.54	11.62	2.31	11.00	2.93	11.53	2.40	11.55	2.38	10.93	3.00
6MW6S	12.16	8.43	3.73	9.07	3.09	8.75	3.41	9.17	2.99	9.02	3.14	8.90	3.26
6MW6D	10.02	8.70	1.32	9.35	0.67	9.00	1.02	9.50	0.52	9.38	0.64	9.15	0.87
2LMW18S	77.60	4.95	72.65	5.86	71.74	5.97	71.63	6.52	71.08	7.00	70.60	6.37	71.23
2LMW18D	77.34	5.68	71.66	6.93	70.41	7.71	69.63	11.13	66.21	12.34	65.00	9.32	68.02
2LMW19S	93.50	8.76	84.74	14.91	78.59	16.74	76.76	18.91	74.59	19.28	74.22	15.88	77.62
2LMW19D	93.90	8.78	85.12	14.88	79.02	16.86	77.04	19.14	74.76	19.47	74.43	16.03	77.87
2LMW20S	87.35	14.37	72.98	14.74	72.61	14.98	72.37	15.61	71.74	15.92	71.43	16.07	71.28
2LMW20D	87.55	7.79	79.76	10.42	77.13	11.15	76.40	12.92	74.63	13.41	74.14	10.35	77.20

TABLE 4-10 (Continued)
MONTHLY WATER LEVELS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well Number	Reference Elevation (feet msl)	March 30, 1994		May 3, 1994		May 26, 1994 ⁽²⁾		June 28, 1994		July 26, 1994		August 23-24, 1994 ⁽³⁾	
		Day 89		Day 123		Day 146		Day 180		Day 207		Day 235	
		DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation
2WMW2D	110.22	NA	NA	26.82	83.40	26.93	83.29	33.47	76.75	35.00	75.22	30.26	79.96
2WMW3S	81.04	6.57	74.47	5.66	75.38	7.62	73.42	8.19	72.85	8.51	72.53	6.83	74.21
2WMW3D	81.36	4.82	76.54	7.61	73.75	6.15	75.21	7.88	73.48	8.19	73.17	6.13	75.23
2WMW5S	76.48	2.96	73.52	2.47	74.01	3.58	72.90	4.51	71.97	5.26	71.22	3.95	72.53
2WMW5D	75.96	1.71	74.25	3.43	72.53	2.57	73.39	3.85	72.11	4.68	71.28	3.28	72.68
2WMW21S	76.47	4.08	72.39	4.30	72.17	4.31	72.16	4.61	71.86	5.00	71.47	4.15	72.32
2WMW21D	74.79	2.35	72.44	2.70	72.09	2.78	72.01	3.29	71.50	3.94	70.85	3.07	71.72
OSW 12	139.63	7.84	131.79	12.72	126.91	14.26	125.37	16.72	122.91	18.72	120.91	20.09	119.54
Monthly Average			41.92		41.80		41.92		41.33		40.73		40.78

TABLE 4-10 (Continued)
MONTHLY WATER LEVELS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well Number	Reference Elevation (feet msl)	September 28, 1994		October 31, 1994		November 27, 1994		December 21, 1994		February 2, 1995		February 23, 1995		Standard Deviation (Feet)
		Day 271		Day 304		Day 331		Day 355		Day 398		Day 419		
		DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	
2DMW16S	37.85	4.70	33.15	8.79	29.06	5.70	32.15	5.40	32.45	6.10	31.75	5.61	32.24	1.616
2DMW16D	37.69	4.55	33.14	8.34	29.35	5.79	31.90	5.57	32.12	5.89	31.80	5.53	32.16	1.577
2DMW23D	81.82	28.23	53.59	36.98	44.84	28.49	53.33	19.76	62.06	19.47	62.35	18.58	63.24	6.802
2DMW24S	36.29	3.81	32.48	8.64	27.65	6.49	29.80	6.30	29.99	6.43	29.86	6.23	30.06	1.934
2DMW24D	34.54	4.23	30.31	9.68	24.86	8.42	26.12	8.15	26.39	7.87	26.67	7.55	26.99	2.662
2DMW25S	34.98	7.88	27.10	9.59	25.39	8.25	26.73	7.76	27.22	8.41	26.57	7.80	27.18	0.925
2DMW25D	33.46	8.30	25.16	10.19	23.27	8.65	24.81	7.94	25.52	8.25	25.21	7.91	25.55	1.206
2DMW27S	28.17	12.31	15.86	12.87	15.30	11.97	16.20	11.02	17.15	11.21	(8)	11.45	(8)	0.984
2DMW27D	27.95	13.17	14.78	13.68	14.27	12.62	15.33	11.90	16.05	(8)	(8)	12.09	15.86	1.597
2LMW7S	84.37	11.15	73.22	11.74	72.63	9.34	75.03	10.14	74.23	10.28	74.09	10.36	74.01	1.016
2LMW7D	85.16	7.14	78.02	9.42	75.74	5.92	79.24	5.57	79.59	5.99	79.17	5.79	79.37	1.683
2WMW22D	121.62	23.80	97.82	25.15	96.47	22.31	99.31	18.68	102.94	18.66	102.96	19.25	102.37	2.934
3MW12D	42.20	0.75	41.45	0.78	41.42	0.00	42.20	2.66	39.54	0.46	41.74	0.57	41.63	0.248
3MW12S	43.51	3.26	40.25	2.85	40.66	2.59	40.92	0.43	43.08	2.58	40.93	2.56	40.95	0.392
7MW3S	45.71	8.63	37.08	6.95	38.76	6.25	39.46	6.06	39.65	6.22	39.49	6.00	39.71	0.915
7MW3D	46.67	6.14	40.53	9.70	36.97	8.54	38.13	8.43	38.24	8.61	38.06	8.52	38.15	1.070
19MW4	7.09	NA	NA	NA	NA	NA	NA	4.58	2.51	4.43	2.66	NA	NA	0.273
SG-4	32.10	5.46	26.64	5.62 ⁽⁵⁾	NA	NA	NA	5.32	26.78	5.23	26.87	5.24	26.86	0.450
SG-5	41.42	2.94	38.48	3.10	38.32	3.00	38.42	2.82	38.60	2.88	38.54	2.78	38.64	0.227
SG-6	85.29	15.00	70.29	14.19	71.10	15.12	70.17	14.97	70.32	15.00	70.29	15.55	69.74	0.415
8MW6S	9.66	6.73	2.93	6.97	2.69	7.30	2.36	6.85	2.81	6.96	2.70	7.01	2.65	0.308
8MW6D	9.62	5.69	3.93	6.34	3.28	6.68	2.94	6.50	3.12	5.60	4.02	7.57	2.05	0.798

TABLE 4-10 (Continued)
MONTHLY WATER LEVELS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well Number	Reference Elevation (feet msl)	September 28, 1994		October 31, 1994		November 27, 1994		December 21, 1994		February 2, 1995		February 23, 1995		Standard Deviation (Feet)
		Day 271		Day 304		Day 331		Day 355		Day 398		Day 419		
		DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	
8MW8S	19.68	15.27	4.41	16.71	2.97	14.30	5.38	15.30	4.38	15.36	4.32	15.45	4.23	0.641
8MW8D	19.53	16.07	3.46	15.71	3.82	16.71	2.82	16.29	3.24	15.79	3.74	16.90	2.63	0.483
15MW3S	26.26	5.60	20.66	6.35	19.91	5.94	20.32	4.81	21.45	3.84	22.42	3.59	22.67	1.098
ERM-4	21.90	4.83	17.07	5.38	16.52	5.33	16.57	4.86	17.04	NA	NA	NA	NA	0.553
OBG-7	25.15	7.24	17.91	7.65	17.50	7.65	17.50	7.34	17.81	6.86	18.29	6.80	18.35	0.691
13MW1	13.36	9.20	4.16	10.53	2.83	10.49	2.87	10.00	3.36	10.39	2.97	10.28	3.08	0.418
13MW8	7.34	5.18	2.16	6.22	1.12	4.35	2.99	5.44	1.90	5.67	1.67	6.14	1.20	0.846
13MW18	12.12	8.91	3.21	9.21	2.91	9.15	2.97	8.89	3.23	9.10	3.02	9.01	3.11	0.288
6MW3S	⁽¹⁰⁾	3.89	2.21	NA	NA	NA	NA	NA	NA	1.71	NA	2.91	NA	0.842
6MW3D	⁽⁸⁾	2.35	NA	NA	NA	NA	NA	NA	NA	2.22	NA	3.40	NA	NA
6MW5S	13.88	11.19	2.69	11.98	1.90	11.84	2.04	11.45	2.43	11.61	2.27	10.95	2.93	0.450
6MW5D	13.93	11.17	2.76	11.95	1.98	11.83	2.10	11.44	2.49	11.59	2.34	10.95	2.98	0.448
6MW6S	12.16	9.22	2.94	9.53	2.63	9.35	2.81	9.16	3.00	9.00	3.16	8.93	3.23	0.285
6MW6D	10.02	8.98	1.04	9.69	0.33	9.62	0.40	9.35	0.67	8.35	1.67	9.19	0.83	0.387
2LMW18S	77.60	6.42	71.18	6.97	70.63	6.21	71.39	5.91	71.69	6.37	71.23	5.84	71.76	0.555
2LMW18D	77.34	9.33	68.01	10.51	66.83	NA	NA	NA	NA	8.77	68.57	7.33	70.01	2.052
2LMW19S	93.50	16.42	77.08	19.85	73.65	15.79	77.71	13.69	79.81	14.68	78.82	15.48	78.02	2.948
2LMW19D	93.90	16.53	77.37	20.10	73.80	15.96	77.94	13.64	80.26	14.68	79.22	15.58	78.32	3.024
2LMW20S	87.35	15.01	72.34	15.73	71.62	8.50	78.85	17.95	69.40	18.08	69.27	17.65	69.70	2.505
2LMW20D	87.55	11.13	76.42	13.49	74.06	11.12	76.43	9.93	77.62	10.61	76.94	10.65	76.90	1.600
2WMW2D	110.22	32.92	77.30	34.41	75.81	29.90	80.32	27.00	83.22	27.04	83.18	25.66	84.56	3.481
2WMW3S	81.04	7.64	73.40	7.91	73.13	7.71	73.33	7.65	73.39	7.66	73.38	7.60	73.44	0.768

TABLE 4-10 (Continued)
MONTHLY WATER LEVELS⁽¹⁾
NSB-NLON, GROTON, CONNECTICUT

Well Number	Reference Elevation (feet msl)	September 28, 1994		October 31, 1994		November 27, 1994		December 21, 1994		February 2, 1995		February 23, 1995		Standard Deviation (Feet)
		Day 271		Day 304		Day 331		Day 355		Day 398		Day 419		
		DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	DTW	Water Elevation	
2WMW3D	81.36	6.68	74.68	8.34	73.02	6.81	74.55	5.97	75.39	5.95	75.41	6.23	75.13	1.071
2WMW5S	76.48	3.98	72.50	4.67	71.81	3.86	72.62	3.58	72.90	3.64	72.84	2.63	73.85	0.820
2WMW5D	75.96	3.25	72.71	3.97	71.99	3.25	72.71	2.70	73.26	2.71	73.25	3.50	72.46	0.766
2WMW21S	76.47	4.41	72.06	3.85	72.62	3.82	72.65	4.65	71.82	4.55	71.92	4.48	71.99	0.342
2WMW21D	74.79	3.30	71.49	3.62	71.17	3.33	71.46	2.98	71.81	2.95	71.84	2.82	71.97	0.431
OSW 12	139.63	19.98	119.65	21.58	118.05	20.35	119.28	16.53	123.10	13.62	126.01	13.52	126.11	4.065
Monthly Average			41.19		40.97		41.83		41.17		43.41		43.75	

- 1 Depth to water (DTW) and groundwater elevations are in feet and feet msl, respectively.
- 2 Heavy rain May 25, 1994 (18:00 to 21:00 hours).
- 3 Light rain August 22, 1994.
- 4 Well purged days earlier, not fully recovered.
- 5 No surface water at location, measured to channel bed.
- 6 Stickup damaged as of 5/3/94; reference elevation unknown.
- 7 NA - Data not available.
- 8 Well damaged as of February 2, 1995; reference elevation unknown.
- 9 Well obstructed due to construction, water level measurement could not be taken.
- 10 Well has been modified to flush mount as of February 2, 1995; reference elevation unknown.

TABLE 4-11

SEASONAL VARIATIONS - HYDRAULIC GRADIENT OF THE NORTHERN VALLEY
NSB-NLON, GROTON, CONNECTICUT

Date	Hydraulic Gradient		
	2LMW19S To 2LMW7S	2LMW7S To 2DMW24S	2DMW24S To 2DMW27S
March 20, 1994	0.0052	0.0319	0.0200
May 3, 1994	0.0027	0.0339	0.0178
May 26, 1994	0.0018	0.0312	0.0219
June 29, 1994	0.0010	0.0309	0.0220
July 26, 1994	0.0012	0.0305	0.0219
August 23 & 24, 1994	0.0025	0.0310	0.0214
September 28, 1994	0.0022	0.0313	0.0213
October 31, 1994	0.0006	0.0346	0.0158
November 27, 1994	0.0015	0.0348	0.0174
December 21, 1994	0.0032	0.0340	0.0165
February 2, 1995	0.0027	0.0340	NA ⁽¹⁾
February 23, 1995	0.0023	0.0338	NA

1 NA - Not available

TABLE 4-12

SEASONAL VARIATIONS - HYDRAULIC GRADIENT OF THE SOUTHERN VALLEY
NSB-NLON, GROTON, CONNECTICUT

Date	Hydraulic Gradient			
	15MW3S To OGB-7	OGB-7 To ERM-4	ERM-4 To 8MW8S	8MW8S To 8MW6S
March 20, 1994	NA ⁽¹⁾	0.0027	0.0196	0.0069
May 3, 1994	0.0078	0.0033	0.0204	0.0057
May 26, 1994	0.0073	0.0025	0.0212	0.0032
June 29, 1994	0.0062	0.0026	0.0200	0.0053
July 26, 1994	0.0045	0.0027	0.0195	0.0054
August 23 & 24, 1994	0.0055	0.0012	0.0208	0.0031
September 28, 1994	0.0055	0.0016	0.0195	0.0049
October 31, 1994	0.0048	0.0019	0.0208	0.0009
November 27, 1994	0.0056	0.0018	0.0172	0.0101
December 21, 1994	0.0073	0.0015	0.0195	0.0052
February 2, 1995	0.0083	NA	NA	0.0054
February 23, 1995	0.0086	NA	NA	0.0053

1 NA - Not Available.

TABLE 4-13
TOTAL POPULATIONS - NEIGHBORING TOWNS/COMMUNITIES
NSB-NLON, GROTON, CONNECTICUT

Statistic	Groton				Ledyard	
	Town of Groton ⁽¹⁾	Neighboring Communities ⁽²⁾			Town of Ledyard ⁽¹⁾	Gales Ferry Section of Ledyard ⁽¹⁾
		Northwest	Pleasant Valley	Naval Subase		
Total Population (1980)	41062	5520	4374	4099	13735	7473
Total Population (1990)	45144	NA ⁽³⁾	NA	NA	14913	7802 ⁽⁴⁾
Total Households (1980)	NA	1391	1216	63	NA	2282
Median Age (1980)	25.5	19.9	23.5	21.4	27.4	27.1

- 1 U.S. Bureau of the Census, 1982. 1980 Census of Population, Volume 1, Characteristics of the Population. U.S. Government Printing Office. Washington, D.C.
- 2 U.S. Bureau of the Census. 1980 Decennial Census Neighborhood Statistics Program, Groton Connecticut.
- 3 NA - Not Available.
- 4 Total population for 1988.

TABLE 4-14
POPULATION AGE DISTRIBUTION⁽¹⁾
SURROUNDING COMMUNITIES
NSB-NLON, GROTON, CONNECTICUT

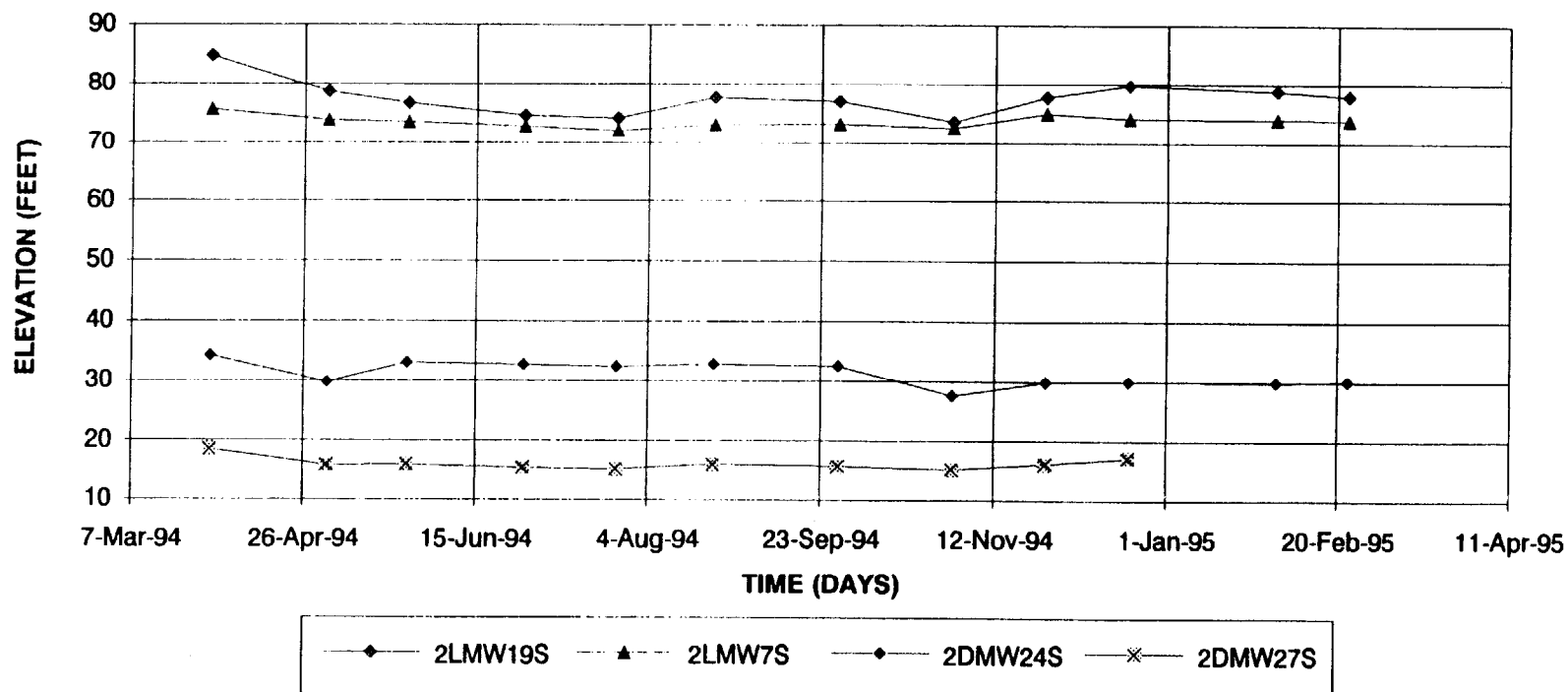
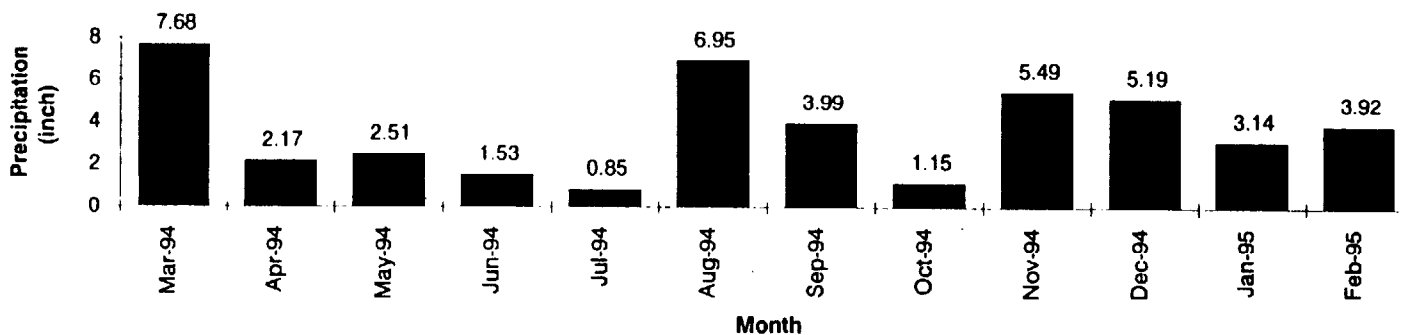
Age Group	Town of Groton		Town of Ledyard	
	Male	Female	Male	Female
0 - 4	1885	1699	549	515
5 - 9	1519	1532	585	555
10 - 14	1508	1395	752	727
15 - 19	2729	1432	742	709
20 - 24	4138	2120	623	547
25 - 29	2700	2002	598	572
30 - 34	1843	1534	611	635
35 - 39	1266	1085	621	642
40 - 44	789	804	470	457
45 - 49	715	762	382	371
50 - 54	814	845	346	324
55 - 59	805	863	261	262
60 - 64	631	667	179	186
65 - 69	450	582	101	117
70 - 74	289	428	67	86
75 - 79	163	351	30	40
80 - 84	142	254	16	28
85 +	87	234	7	22
Median Age	24.3	27.6	26.8	28.1

1 U.S. Bureau of the Census, 1982. 1980 Census of Population, Volume 1, Characteristics of the Population. U.S. Government Printing Office. Washington, D.C.

TABLE 4-15

ENDANGERED SPECIES SIGHTED IN NSB-NLON AREA
NSB-NLON, GROTON, CONNECTICUT

Species	Status	Last Observation
<i>Acipenser oxyrinchus</i> (Atlantic Sturgeon)	State Threatened	1968
<i>Zizia aptera</i> (Golden Alexanders)	State Endangered	1993
<i>Ranunculus cymbalaria</i> (Seaside Crowfoot)	State Endangered	1902
<i>Lespedeza repens</i> (Creeping Bush-clover)	State Special Concern	1932
<i>Aster prenanthoides</i> (Crooked-stem Aster)	State Special Concern Historic	1937
<i>Carex crawfordii</i>	State Special Concern Historic	1933



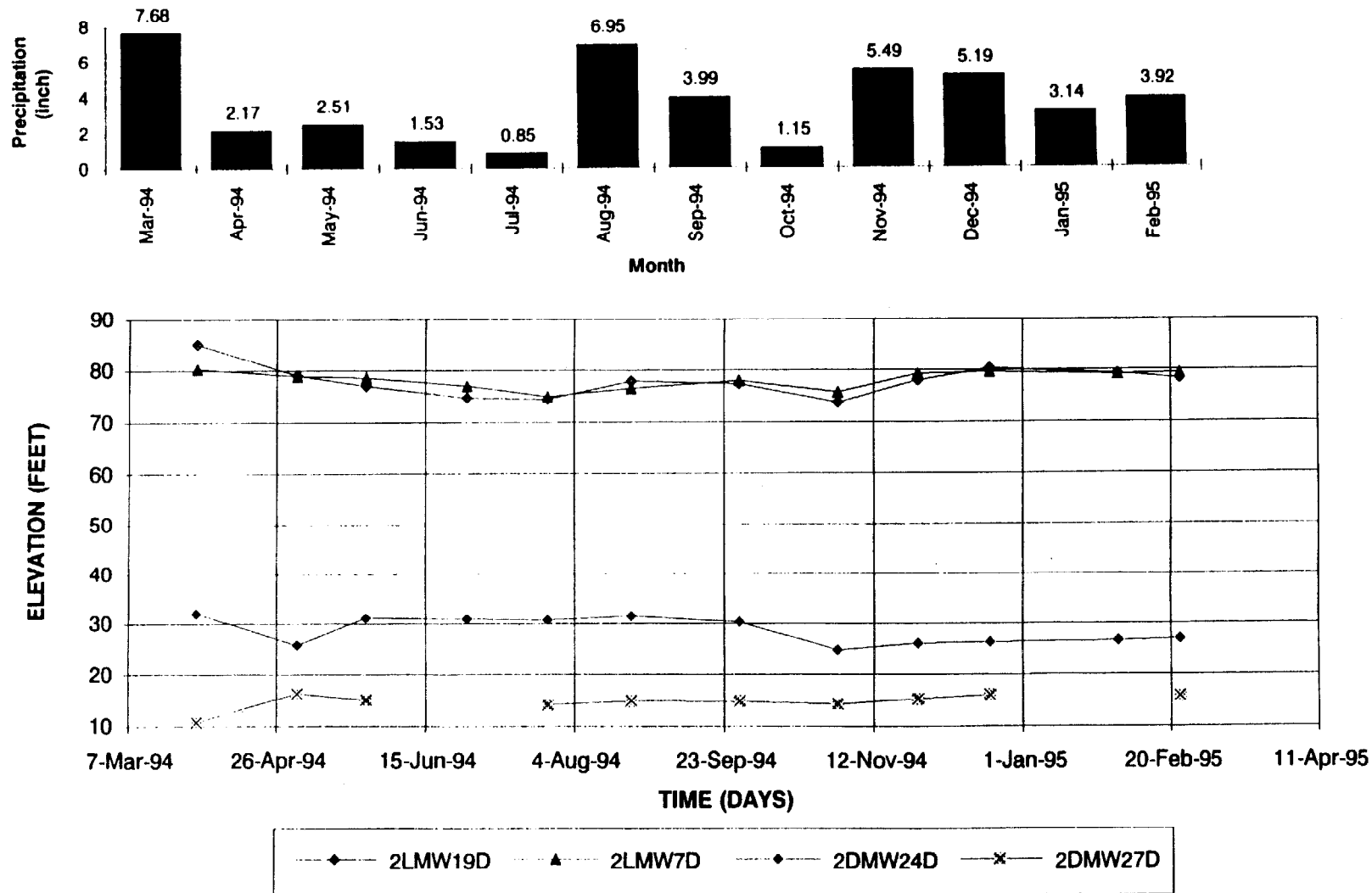
**HYDROGRAPHS FOR SHALLOW WELLS
NORTHERN VALLEY
NSB-NLON. GROTON, CT**

FIGURE 4-1

D-01-95-10

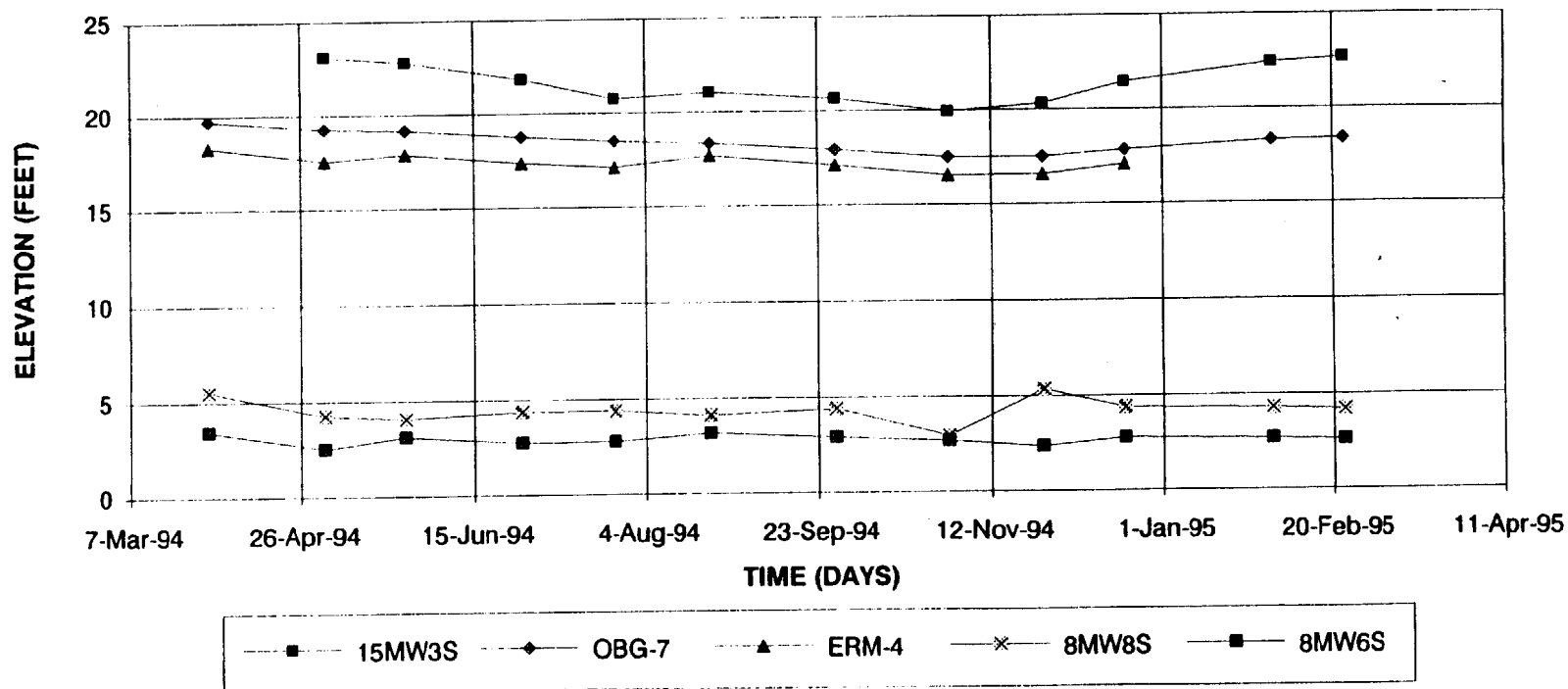
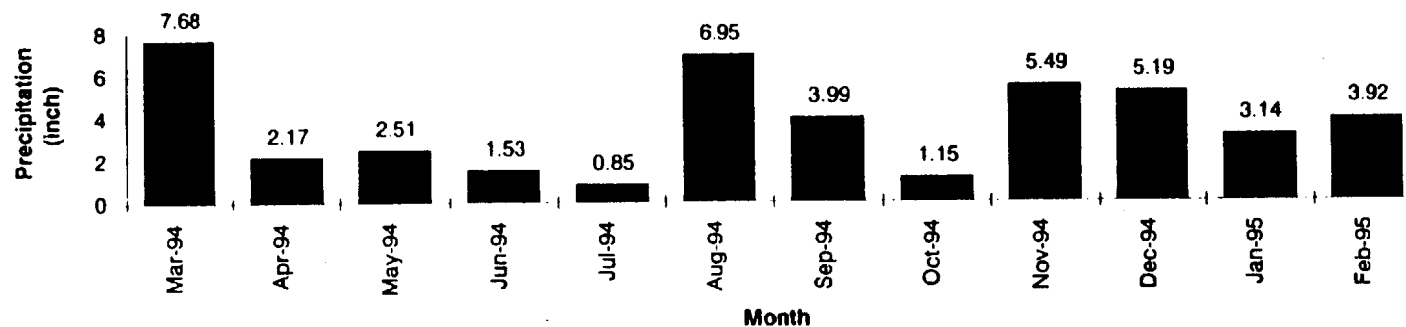
4-72

CTO 129



HYDROGRAPHS FOR DEEP WELLS
NORTHERN VALLEY
NSB-NLON, GROTON, CT

FIGURE 4-2

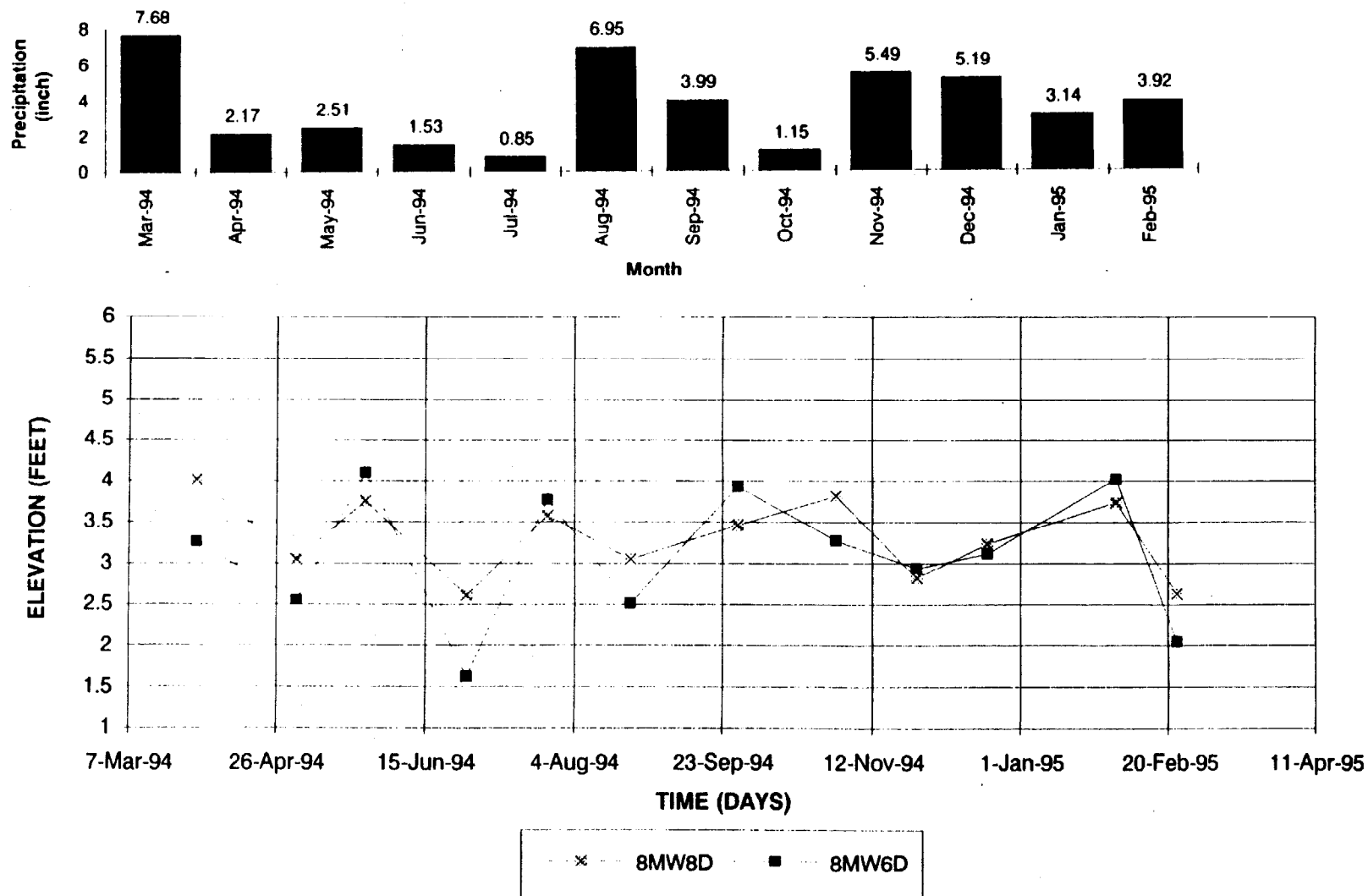


**HYDROGRAPHS FOR SHALLOW WELLS
SOUTHERN VALLEY
NSB-NLON. GROTON, CT**

FIGURE 4-3

D-01-95-10

ACAD: 0:\DATA\CADD\9594\9594GD04.DWG 02/14/96 DGB



HYDROGRAPHS FOR DEEP WELLS
SOUTHERN VALLEY
NSB-NLON, GROTON, CT

FIGURE 4-4

4-74

CTO 129

5.0 CBU DRUM STORAGE AREA - SITE 1

This section provides a site-specific summary of various aspects of the Construction Battalion Unit (CBU) Drum Storage Area investigation. Section 5.1 provides a brief site description. The sampling and analysis program is summarized in Section 5.2. Section 5.3 discusses site physical features. The nature and extent of contamination is discussed in Section 5.4. Contaminant fate and transport is summarized in Section 5.5. Section 5.6 provides the baseline human health risk assessment, Section 5.7 provides the ecological risk assessment and Section 5.8 includes a comparison to state standards. Section 5.9 provides a summary and conclusions.

5.1 SITE DESCRIPTION

The CBU Drum Storage Area is an unpaved area located in the northern section of NSB-NLON adjacent to the deployed personnel parking lot and within the boundary of the Area A Landfill. Figure 5-1 provides the general arrangement of the site. The location of the CBU Drum Storage Area in relationship to other Phase II RI sites is shown on Drawing 1 (Volume III). The site is situated on a flat, open area at the base of a wooded hillside that slopes to the northeast toward the site at a 25 percent grade. The site is approximately 15 feet in width by 30 feet in length. Current photographs of the site are provided in Appendix B.3.

Twenty-six 55-gallon drums of waste oil, lube oil, and paint materials were observed at the site during the 1982 IAS. Some of the drums were reportedly leaking at that time. The IAS report concluded that the site had not been used for several years. Atlantic personnel inspected the site on October 20, 1988 and observed two 55-gallon drums labeled as engine oil. No surface soil staining or stressed vegetation was evident. The drums noted in the IAS report were reportedly removed and properly disposed by the Navy; the two drums observed in 1988 were subsequently removed.

5.2 SITE INVESTIGATIONS

Section 2.0 included a detailed discussion of the general sampling procedures and analytical methods employed during the investigations at NSB-NLON. Sample locations (both Phase I and Phase II) are depicted on Figure 5-2. The remainder of this section summarizes the scope of both the Phase I and Phase II investigations.

5.2.1 Phase I RI

As part of the 1990 Phase I RI of the CBU Drum Storage Area, three surface (0- to 6-inch depth) and three shallow subsurface (12- to 18-inch depth) soil samples were collected from three locations at the site. A seventh sample was a composite of 0-to 6-inch depth samples from the three locations. The sample locations were in the central part of the CBU Drum Storage Area as shown on Figure 5-2. These samples were collected to screen for potential releases associated with past drum storage. Table 5-1 provides a sample-specific summary of the sampling and analytical program for the Phase I RI.

5.2.2 Phase II RI

One monitoring well (1MW2S) was installed during this phase of investigation in a location presumed (based on topography) to be downgradient of the CBU Drum Storage Area. One groundwater sample was collected from this well during each of two sampling rounds. Two additional surface and three subsurface soil samples were collected from the monitoring well boring and two test borings located at the perimeter and downslope of the storage area. The first boring (1TB1) was sampled at depths of 0 to 2 feet and 6 to 8 feet. The second boring (1TB2) at monitoring well 1MW2S location, was sampled at a depth of 12 to 14 feet. The third boring (1TB3), located downslope of the site, was sampled at depths of 0 to 2 feet and 5 to 7 feet. Sample locations are depicted on Figure 5-2. Table 5-2 displays a sample-specific summary of the Phase II RI sampling and analytical program.

5.3 PHYSICAL CHARACTERISTICS

This section presents a summary of site physical characteristics for the CBU Drum Storage Area based on information generated during the Phase I and Phase II RIs. Topography and surface features, surface water, soils, geology, and hydrogeology are discussed in the subsections that follow.

5.3.1 Topography and Surface Features

Figure 5-1 shows the topography and surface features of the CBU Drum Storage Area. Generally, the ground surface slopes to the northeast. Bedrock outcrops are prevalent along the hillside southwest of the site. The hillside ground surface slopes relatively uniformly at a grade of approximately 25 percent across the site as shown on Figure 5-1. Across and northeast of the site, the ground slope flattens across the Area A Landfill. The ground surface elevation at the CBU Drum Storage Area is approximately 85 feet above

mean sea level (based on surveyed test borings). The CBU Drum Storage Area is unpaved and there are no buildings or structures on the site (see photographs in Appendix B.3).

5.3.2 Surface Water Features (Atlantic, August 1992)

Surface drainage from the CBU Drum Storage Area flows northeast across the unpaved Deployed Parking Lot (which covers a portion of the Area A Landfill) and into the Area A Wetland. A downgradient catch basin is located approximately 40 feet northeast of the site, and the associated storm sewer discharges into the Area A Wetland.

5.3.3 Soil Characteristics

The SCS Soils Map (SCS, 1983) classifies the soil at the CBU Drum Storage Area as the Hollis-Charlton-Rock complex. This soil is associated with the central bedrock high on which the CBU Drum Storage Area is located. The soil is defined as stones and boulders intermingled with a dark, fine, sandy loam. Bedrock outcrops are prevalent.

5.3.4 Geology

The bedrock surface across the CBU Drum Storage Area is depicted on Drawing 3 (Volume III). Geologic conditions are shown on cross-section G-G' on Drawing Number 20 (Volume III). The CBU Drum Storage Area is located within the boundary of the Area A Landfill along the southern side. During the Phase II RI field investigation, one test boring (1TB1) was drilled within the site boundary. The overburden consists of silty sand to a depth of 12 feet underlain by sand and gravel to a total drilled depth of 14.5 feet at this location. Fill material (wood fragments, bullets, and plastic) was encountered during drilling as documented in the boring log (Appendix A). Field personnel reported a fuel odor and oily sheen on soils in the top 7 feet of the boring.

Two additional test borings (1TB2 and 1TB3) were drilled outside the site boundary. The overburden observed in these borings also consisted of silty sand. Fill material (gravel, brick, plastic, and aluminum foil) was encountered during drilling as shown in the boring logs. At 1TB2, a fuel odor and oily sheen were noted on soils to a depth of 14 feet. At 1TB3, a clayey silt layer lies beneath the silty sand. This material is similar to the dredge spoil that has been identified beneath the Area A Landfill and within the Area A Wetland.

Bedrock was not encountered in any of the borings. However, according to the bedrock geology map (USGS, 1967), the bedrock is mapped as the Mamacoke Formation. The bedrock surface is expected to slope toward the northeast. The depth to bedrock is expected to be approximately 15 to 30 feet in the vicinity of the CBU Drum Storage Area (the test borings were 14 feet in depth). There appears to be a local bedrock depression at the 2LMW8 well cluster (adjacent to the CBU Drum Storage Area). Bedrock was encountered in the boring for this well at a depth of 42 feet.

5.3.5 Hydrogeology

Groundwater is present within the overburden materials underlying the site. Depth to groundwater ranged from 1 to 9 feet in monitoring well 1MW2S during the three comprehensive water level rounds. Figure 5-3 shows the local shallow overburden groundwater potentiometric surface for the CBU Drum Storage Area. Based on the projected groundwater contours for this area and on ground surface topography, shallow groundwater flow across and downgradient from the CBU Drum Storage Area is expected to be to the northeast. The groundwater elevation at well 1MW2S is similar to the groundwater elevation at well 2LMW8S, both of which are located along the upgradient boundary of the Area A landfill. An upward gradient at the 2LMW8 well cluster suggests that groundwater discharges from the bedrock into the overburden in this area.

An estimate of the seepage velocity was generated using the groundwater contours in Figure 5-3. A flow gradient of 0.04 was calculated from the equipotential contours. The hydraulic conductivity of the overburden is expected to be similar to the hydraulic conductivity of the Area A Landfill (2.7 feet/day). Assuming these values and a porosity of 0.30, the seepage velocity is estimated to be 0.36 feet/day.

5.3.6 Ecological Habitat

The area surrounding the CBU Drum Storage Area is a flat, open area located at the edge of a wooded hillside. The hillside slopes toward the site at a 25 percent grade and is vegetated. The habitat associated with the hillside bordering the CBU Drum Storage Area is best characterized as upland coniferous/deciduous forest. Red/black oaks, yellow birch, mockernut hickory, white oak, eastern hemlock, common spicebush, maple leaf viburnum, and mountain laurel dominate the vegetative cover of this area (Atlantic, 1992). The CBU Drum Storage Area itself provides a poor habitat; the site offers limited cover (i.e., the site is characterized by compacted, supporting minimal vegetation soil) and forage. No ecological receptors are believed to utilize the CBU Drum Storage Area as either a nesting or forage area. However, the nearby hillside does provide habitat for terrestrial ecological receptors. Wildlife inhabiting this hillside

may come in contact with soil at the CBU Drum Storage Area as they move into other areas (e.g., the Area A Wetlands) to forage.

5.4 NATURE AND EXTENT OF CONTAMINATION

This section provides a summary of the nature and extent of contamination at the CBU Drum Storage Area based on both the Phase I and Phase II RIs. The nature and extent of contamination is discussed on a matrix-specific basis in the following subsections. The complete analytical data base is contained in Appendix D.1.

5.4.1 Soil

Table 5-3 presents positive analytical results for all soil samples collected at the site. Table 5-4 presents TCLP results. Table 5-5 presents a summary of the analytical results for soil samples.

2-Butanone, ethylbenzene, methylene chloride, tetrachloroethene, and xylenes were detected in one to three of the six surface soil samples. With the exception of xylenes (300 $\mu\text{g}/\text{kg}$) in sample 1SS3D (at a depth of 1 to 1.5 feet), volatile organic concentrations in surface soils were all 38 $\mu\text{g}/\text{kg}$ or less. These same volatiles plus 1,1,1-trichloroethane were detected at slightly higher concentrations in the subsurface soil samples. For example, the maximum concentrations of ethylbenzene and xylenes in surface soils were 23 $\mu\text{g}/\text{kg}$ and 300 $\mu\text{g}/\text{kg}$, respectively, while the maximum concentrations of these compounds in subsurface soil samples were 79 $\mu\text{g}/\text{kg}$ and 380 $\mu\text{g}/\text{kg}$, respectively. All maximum subsurface soil concentrations were found in the 5 to 7 foot deep sample of boring 1TB3.

Several semivolatiles were detected in the surface and subsurface soil samples. The 0 to 2 foot sample of boring 1TB1, at the perimeter of the site, contained the majority of maximum concentrations among the surface soil samples. The highest concentrations of most compounds overall were noted in the 6- to 8-foot deep sample collected in boring 1TB1, followed by the deeper sample (5 to 7 feet) in the offsite boring (boring 1TB3). The deepest sample collected (12 to 14 feet in monitoring well boring 1TB2) contained the lowest concentrations and the least number of compounds. The semivolatile compounds detected include numerous PAHs, two phthalate esters, 1,4-dichlorobenzene, dibenzofuran, and carbazole. The PAHs are typical constituents of oils and tars, and were found at the highest concentrations with a maximum concentration of phenanthrene (16,000 $\mu\text{g}/\text{kg}$) in boring 1TB1 (0 to 6 feet). Figure 5-4 presents a summary of the concentrations of both carcinogenic and noncarcinogenic PAHs in the surface soil samples.

The only detections of most pesticides and PCBs were in the samples collected from boring 1TB1, which is located on the site boundary. Concentrations of most pesticides/PCBs in the 1TB1 samples decreased with depth. 4,4'-DDD was detected at the highest concentrations (3900 $\mu\text{g/kg}$) in the 0 to 2 foot sample, and (2100 $\mu\text{g/kg}$) in the 6 to 8 foot sample. Other than Aroclor-1254 (420 $\mu\text{g/kg}$) in the 0 to 2 foot sample, all other pesticides/PCBs were detected at concentrations less than 60 $\mu\text{g/kg}$ in the samples collected from 1TB1. Other pesticide/PCB detections include 4,4'-DDD (55 $\mu\text{g/kg}$) in composite surface soil sample 1SS4C, 4,4'-DDD (24 $\mu\text{g/kg}$) and 4,4'-DDT (140 $\mu\text{g/kg}$) in the 12 to 14 foot sample of boring 1TB2, and Aroclor-1248 (360 $\mu\text{g/kg}$) in the 5 to 7 foot sample of boring 1TB3. The presence of DDD, DDT, and Aroclor-1248 in subsurface samples from borings 1TB2 and 1TB3 are most likely attributable to reworking of the soil, particularly since this site is located on the Area A Landfill. These concentrations may also be the result of past pesticide applications or dredge spoil placement (for the deep samples) and probably do not represent the direct disposal of pesticides at the site (because of the low concentrations and sporadic detections).

Maximum concentrations of most metals in both surface and subsurface soil samples were found in the samples from boring 1TB1, with concentrations generally increasing with depth. Maximum concentrations of all metals were higher than the reported NSB-NLON background values (Table 1-2).

Three surface soil samples from the Phase I RI were analyzed for selected metals after TCLP extraction. One sample (1SS1) contained lead in the leachate at a concentration (0.6 mg/L) that exceeded the pollutant mobility Connecticut remediation standard for GB areas (0.15 mg/L), but not the Federal Toxicity Characteristic regulatory level (5.0 mg/L).

5.4.2 Groundwater

Positive analytical results for the groundwater samples are presented in Table 5-6. One monitoring well was sampled twice at the site. This well is located on the side/downgradient edge of the site.

The number and concentration of volatile organic compounds found in the groundwater samples were low. For instance, chlorobenzene and xylenes were detected only in Round 1 of the Phase II RI at concentrations of 12 $\mu\text{g/L}$ and 24 $\mu\text{g/L}$, respectively. No volatile organics were detected in Round 2 of the Phase II RI. It should be noted that xylenes were the volatile soil contaminant found at the highest concentrations. However, xylenes were not detected at significant concentrations or frequencies in the groundwater.

No pesticides or PCBs were detected in the groundwater samples during either round of the Phase II RI. Total petroleum hydrocarbons (TPH) were detected at 1,200 $\mu\text{g/L}$ in the Round 2 sample, but were not detected in the Round 1 sample.

Several semivolatile organic compounds were also detected in the Phase II RI groundwater samples. In the Round 1 sample, naphthalene and carbazole were found at the highest concentrations (9 $\mu\text{g/L}$ and 7 $\mu\text{g/L}$, respectively). Several other PAHs, diethylphthalate, 4-methylphenol, and dibenzofuran were also detected in the Round 1 sample, but at concentrations below 4 $\mu\text{g/L}$. The same compounds plus di-n-butylphthalate, fluoranthene, and pyrene were detected at slightly higher concentrations in the Round 2 sample. For instance, naphthalene and carbazole were detected at concentrations of 31 $\mu\text{g/L}$ and 19 $\mu\text{g/L}$, respectively, in Round 2. Phenanthrene was detected at a concentration of 22 $\mu\text{g/L}$. The maximum concentration of all other semivolatiles was 13 $\mu\text{g/L}$.

All of the metals detected were found at roughly similar concentrations in the total versus dissolved samples during both Phase II RI rounds. These results indicate that there was a minimal amount of suspended sediment in the samples (i.e., the water was not turbid). This may be attributable to the use of low-flow sampling techniques. Concentrations of most metals increased slightly from Round 1 to Round 2. Although lead was detected in the soil samples and, as noted in Section 5.4.1, in one of the TCLP leachates at a level exceeding Connecticut criterion for pollutant mobility, lead was not detected in the groundwater samples.

5.5 CONTAMINANT FATE AND TRANSPORT

The analytical results presented in the preceding section appear to indicate that organic chemicals (primarily PAHs) are present beyond the identified site boundaries of the CBU Drum Storage Area. This can be expected since the CBU Drum Storage Area lies within the confines of the Area A landfill. The site is unpaved, and the ground slopes toward the northeast, which may promote erosional transport. Contamination also appears to have migrated vertically, as evidenced by the presence of volatile and some of the more soluble semivolatile organic compounds at depth in the soil, as well as in the groundwater, although no notable potential source areas were noted in the analytical soil sample results.

Furthermore, the site is located within the boundary of the Area A landfill and it would be expected that contamination would be present beyond the CBU Drum Storage Area site boundary.

5.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the site-specific risk assessment for the identified exposure scenarios for the CBU Drum Storage Area. The risk assessment methodology was described in Section 3.3, and detailed calculations are contained in Appendix F.4.

5.6.1 Data Evaluation

Chemicals of concern (COCs) at this site were selected using the risk-based COC screening levels described in Section 3.3.1. All data collected during the Phase I and II RIs, except data from the composite soil sample (1SS4C) collected during the Phase I RI and data from soil samples collected at depths greater than 10 feet, were used to select COCs for soil and groundwater. COC summary screening tables for all media are contained in Appendix F.4.

The following compounds were detected at maximum concentrations that exceeded the risk-based COC screening levels for residential soil:

- PAHs (benzo(b)fluoranthene, benzo(a)anthracene, benzo(a)pyrene, and indeno (1,2,3-cd)pyrene).
- 4,4'-DDD.
- PCBs (Aroclor-1248 and -1254).
- Metals (antimony, arsenic, beryllium, chromium, manganese, and vanadium).
- TPH

Benzo(b)fluoranthene, indeno (1,2,3-cd)pyrene, Aroclor-1248, and chromium were selected as COCs for the "all soil" (soil from depths of 0 to 10 feet) category only. Maximum detections of these four chemicals in the surface soil samples were below the risk-based COC screening levels. TPH was also qualitatively identified as a COC for soil because the maximum detection (9,800 mg/kg) exceeded the 500 mg/kg Connecticut remediation standard. Because of the limited number of soil samples collected, the average and maximum detected concentrations were used as the exposure concentrations for the CTE and RME, respectively.

Maximum detections in soil were also compared to USEPA soil screening levels (SSLs) for migration to groundwater, as summarized in the COC screening tables (Appendix F.4). Maximum detections for several chemicals (methylene chloride, benzo(a)anthracene, carbazole, chrysene, 4,4'-DDD, dieldrin, barium,

chromium, and nickel) detected in the site soil samples exceeded the SSLs, indicating the potential for these chemicals to migrate to groundwater and potentially impact the quality of the groundwater.

For groundwater, several chemicals were detected at maximum concentrations that exceeded the risk-based COC screening criteria for residential use of groundwater. These compounds are:

- Chlorobenzene.
- Carbazole.
- Metals (arsenic and manganese).

The average chemical concentration of the Round 1 and 2 groundwater samples for the one well at the site (well 1MW2S) serves as the exposure concentration for both the RME and CTE scenarios.

Several organic chemicals (2-methylnaphthalene, acenaphthylene, benzo(g,h,i)perylene, and phenanthrene) and some inorganic essential human nutrients (calcium, magnesium, potassium, and sodium) detected in the site media were not identified as COCs because no toxicity criteria are available to quantitatively evaluate these chemicals. In addition, USEPA Region I does not advocate a quantitative evaluation of exposure to aluminum and iron because the only available toxicity criteria for these chemicals are provisional reference doses based on allowable intakes rather than adverse effect levels. The uncertainty section of the baseline risk assessment, Section 3.3.5, contains a discussion of exposure to these compounds and the resulting limitations associated with the quantitative risk estimates.

Table 5-7 presents a summary of the potential chemicals of concern and exposure concentrations for the CBU Drum Storage Area.

5.6.2 Exposure Assessment

Because this site is isolated, and the only use of the site in the foreseeable future is as a storage area, the only potential receptors evaluated are older child trespassers and construction workers. Construction workers were included since the planned capping of the Area A landfill is expected to encompass the CBU Drum Storage Area. The characteristics of both the CTE and the RME scenarios for these receptors were defined in Section 3.3.3.

The older child trespasser is assumed to come into contact with surface soil only on an infrequent basis, while construction workers are expected to be exposed to "all soil" (soil from depths of 0 to 10 feet) during

the entire length of the construction project. Contact for both receptors would include incidental ingestion of soil and dermal contact with soil. In addition, construction workers could also be dermally exposed to groundwater during intrusive activities.

The inhalation of fugitive dust and volatile emissions from soil is evaluated qualitatively by a comparison of maximum soil concentrations to USEPA SSLs for the inhalation pathway. This comparison is provided in the COC summary screening tables, located in Appendix F.4. Maximums for all soil chemicals were less than the SSLs. This comparison indicates the relative insignificance of the inhalation exposure pathway, and eliminates the need for further quantitative evaluation of this exposure route.

5.6.3 Risk Characterization

A summary of the quantitative risk assessment for the CBU Drum Storage Area is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for the RME and CTE, are outlined in Table 5-8 for the older child trespasser and construction worker. Sample calculations are provided in Appendix F.3. Chemical-specific risks for the site are presented in Appendix F.4.

5.6.3.1 Noncarcinogenic Risks

Cumulative Hazard Indices (HIs) for the trespasser and construction worker range from 6.2E-3 (CTE, trespasser) to 3.5E-1 (RME, construction worker). All values were less than unity, indicating that no toxic effects are anticipated for these receptors under the defined exposure scenarios.

5.6.3.2 Carcinogenic Risks

Estimated carcinogenic risks are minimal for the older child trespasser exposed to surface soil and the construction worker exposed to "all soil" (soil from depth of 0 to 10 feet) and groundwater. Cumulative incremental cancer risks for the construction worker under both scenarios and the older child trespasser under the CTE were less than 1E-6. The cumulative carcinogenic risk for the older child trespasser under the RME (2.0E-6) was within the USEPA's target risk range (1E-4 to 1E-6). Incidental ingestion is the primary route of exposure for the older child trespasser. Arsenic and beryllium contribute to the majority of the risk for the RME scenario.

5.6.3.3 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 3.3.5. Site-specific uncertainties for the CBU Drum Storage Area risk evaluation are presented below.

Some inorganic chemicals detected in site soil samples may be attributable to naturally occurring compounds. Background levels for metals in soil at NSB-NLON, developed by Atlantic Environmental Services, Inc., were presented in Table 1-2. Reported concentrations of aluminum, cobalt, magnesium, and potassium in the site surface soils were below the established background levels. Arsenic and beryllium, which are the major contributors to the calculated carcinogenic risks, may also be a result of background conditions as maximum detections of these analytes in surface soil (4.8 mg/kg and 1.0 mg/kg, respectively) only slightly exceeded the NSB-NLON background concentrations (3.6 mg/kg and 0.72 mg/kg).

5.7 ECOLOGICAL RISK ASSESSMENT

This section contains a site-specific ecological risk assessment for the CBU Drum Storage Area. Both maximum and average exposure point concentrations were considered in determining potential risks to ecological receptors. The process followed to determine exposure point concentrations and the methodology used to characterize risks to ecological receptors is summarized in Section 3.4. Detailed calculations are provided in Appendix I.1.

5.7.1 Conceptual Site Model

Soil samples were collected from the CBU Drum Storage Area and analyzed. Ecological receptors are most likely to be exposed to chemicals associated with this site by direct contact with the surface soil as they move from the wooded hillside bordering the CBU Drum Storage Area to forage in the nearby Area A Wetland.

5.7.2 Exposure Assessment

Although the CBU Drum Storage Area does not currently represent a desirable habitat for wildlife receptors, it was conservatively assumed to be inhabited for the purposes of this ecological risk assessment. Complete exposure pathways for this site therefore included potential uptake via roots by terrestrial vegetation and exposure of soil invertebrates via direct contact with contaminants present in soil moisture or through

ingestion. Complete exposure pathways for small mammals included direct contact with contaminated surface soil, incidental ingestion of surface soil while foraging, and consumption of contaminated prey. Predators could be exposed to chemicals at this site via consumption of contaminated prey or incidental ingestion of surface soil while foraging on the site.

5.7.3 Receptor Organisms

As noted in Section 5.3.6, the CBU Drum Storage Area is characterized by compacted soil that supports limited vegetation. As such, this site is unlikely to represent desirable habitat for wildlife nor is it likely to represent a foraging area for ecological receptors. However, in order to evaluate potential impacts to wildlife receptors, it was assumed that the CBU Drum Storage Area was vegetated, that the site supports a population of soil invertebrates, and that short-tail shrews both inhabit and forage in the area, preying on soil invertebrates (earthworms). The short-tail shrew in turn serve as prey for red-tailed hawks. The same conservative assumptions summarized in Section 3.4.4.2 were retained for this assessment.

5.7.4 Chemicals of Concern

As discussed in Section 5.7.1, surface soil (0 to 2 feet) is the only medium with which ecological receptors are likely to come in contact. Chemicals of concern associated with this medium were selected by comparing exposure point concentrations (both maximum and average values; Appendix I.1) detected in surface soil samples collected from the site to the following benchmarks (see also Section 3.4.2):

- Inorganic concentrations were compared to concentrations of inorganic constituents present in NSB-NLON background samples.
- With the exception of aluminum (see Section 5.7.5.1), inorganics present in concentrations greater than concentrations of background constituents and all organic compounds were compared to conservative benchmark values protective of terrestrial vegetation, soil invertebrates, the short-tailed shrew, and the red-tailed hawk.

Chemicals of concern identified as a result of comparing both the maximum and average concentrations of analytes detected in surface soils collected from this area are summarized in Table 5-9.

5.7.5 Risk Characterization

5.7.5.1 Terrestrial Vegetation

As discussed in Section 3.4.2.3, risks to terrestrial vegetation were determined by comparing concentrations of contaminants to conservative, phytotoxic benchmarks. As noted above, aluminum was found in concentrations less than background concentrations but was still present in concentrations that exceeded its benchmark value for terrestrial vegetation. This metal was therefore retained as a chemical of concern at this site. As discussed in Section 3.4.2.3, the benchmark values listed in Will and Suter (1994) are conservative and do not consider site-specific soil characteristics which may affect bioavailability of chemicals (and their potential toxicity) to plants. Both maximum and average chemical concentrations detected in surface soil samples collected from this site were compared to these phytotoxic benchmark values and Hazard Quotients (HQs) were determined. Chemicals associated with the CBU Drum Storage Area were considered to represent a risk to terrestrial vegetation if the HQs exceeded 1.0. The HQs calculated by comparing maximum detected concentrations to benchmark values are summarized in Table 5-10.

Comparisons of maximum soil concentrations detected at the CBU Drum Storage Area to phytotoxic benchmark values identified 9 inorganics with HQs greater than 1.0. Of these analytes, aluminum (HQ = $2.0E+2$), vanadium (HQ = $9.3E+1$), and chromium (HQ = $3.4E+1$) represented those metals most likely to result in an adverse impact to terrestrial vegetation (Table 5-10). When average concentrations of surface soil chemicals were compared to the phytotoxic benchmarks, HQs decreased (the HQs for aluminum, vanadium, and chromium were $1.7E+2$, $5.2E+1$, and $2.4E+1$, respectively) and HQs associated with copper and nickel were less than one (Table 5-11). As noted above, NSB-NLON background concentrations also exceed the phytotoxic benchmark value for aluminum, suggesting that this benchmark value may be too conservative for this area. However, the results of this conservative screening assessment do suggest that the limited vegetation currently supported in CBU Drum Storage Area is potentially at risk.

5.7.5.2 Terrestrial Fauna

Soil Invertebrates

Conservative benchmark values protective of earthworms were used to identify potential risks to soil invertebrates inhabiting the CBU Drum Storage Area. Although this area is characterized by bare, compacted soil (Section 5.3.6) and it is unlikely that these surface soils currently support a robust population

of soil invertebrates, potential risks to these organisms were evaluated. The maximum and the average concentrations of inorganics detected in surface soil (0 to 2 feet) samples collected from this site were compared to the background concentrations. Inorganics present at concentrations greater than NSB-NLON background and all organic compounds were then compared to benchmark values developed for earthworms (see Section 3.4.2.3) and HQs were determined (see Appendix I.1). Chemicals associated with the CBU Drum Storage Area were considered to represent a risk to terrestrial invertebrates if the HQs exceeded 1.0. The HQs determined for this site are summarized in Table 5-12.

Of the chemicals detected in surface soil samples, only three metals (copper, lead, and chromium) were present at maximum concentrations that represent a potential risk to soil invertebrates (Table 5-12). However, when average concentrations of these metals were compared to these benchmark values, only copper had an HQ greater than 1.0 (HQ = 2.4; Appendix I.1). As discussed in Section 3.4.2.3, data concerning the toxicity of metals in soil to soil invertebrates is limited and difficult to interpret due to the influence that soil characteristics have on contaminant bioavailability. With the exception of copper, the main concern associated with soil invertebrates is that chemicals may accumulate in these organisms in concentrations that may adversely impact predator species. Copper, on the other hand, has been demonstrated to eliminate earthworms from surface soils. The results of this assessment indicate that soil invertebrates that come in contact with the maximum concentrations of copper, chromium, and lead detected at the CBU Drum Storage Area are at risk. Exposure to average concentrations of copper also represent a potential risk to these receptors.

Terrestrial Vertebrates

Although the CBU Drum Storage Area currently doesn't represent a desirable habitat for terrestrial vertebrate receptors, potential risks to these types of receptors were evaluated by examining risks to short-tailed shrews and the red-tailed hawk. Exposure pathways considered in the assessment for this site included the ingestion of prey and the incidental ingestion of soil. Because soil was the only medium considered for this site, potential risks associated with the ingestion of water were not considered. All calculations performed for representative animals potentially inhabiting the CBU Drum Storage Area are contained in Appendix I.1.

As discussed in Section 3.5.3, risks to terrestrial receptors are expressed in terms of Hazard Indices (HIs), which are the sum of chemical-specific HQs. As noted in Section 5.7.4, this risk assessment evaluated potential risks associated with exposure to the maximum concentrations (conservative or worst-case scenario) and to the average concentration (more "realistic" exposure scenario) of site chemicals. HIs calculated for each terrestrial receptor exposed to the maximum soil concentrations associated with the CBU

Drum Storage Area are summarized in Table 5-13 while HI values based on comparisons of average concentrations in surface soil to benchmark values are summarized in Table 5-14.

The HI calculated for the short-tailed shrew using maximum surface soil concentrations was $6.3E+2$, indicating that this species may be at risk. Vanadium was the greatest contributor to risk (63.2%), followed by antimony (19.4%), and chromium (5.3%). Ingestion of soil contributes 58.4% of the total exposure, and the ingestion of food (earthworms) accounts for 41.6% (Table 5-13).

Use of average soil concentrations to determine the HI value for this receptor resulted in a somewhat lower HI ($HI = 3.7E+2$; Table 5-14). Vanadium, antimony, and chromium also contributed significantly to this receptor's potential risk and ingestion of soil remained the primary route of exposure to soil contaminants (i.e., 58.3% of total HI).

When compared to acute toxicity values, only vanadium exceeded its benchmark value under the maximum scenario (Appendix I.1). An $HI > 1$ was also calculated for vanadium using the acute benchmark for this receptor.

When the maximum concentrations in surface soil were compared to conservative benchmark values developed for the red-tailed hawk, an HI of $4.4E+2$ was calculated (Table 5-13). For this raptor, 4,4'-DDD was the dominant contributor to risk, accounting for 96.4% of the HI while 4,4'-DDE contributed 1.4%. All other contaminants contributed 2.2% (Table 5-13). Ingestion of prey (in this case, shrews) contributed significantly (82.8%) to this receptor's total exposure.

While use of average surface soil concentrations resulted in a lower HI for this receptor ($HI = 2.2E+2$; Table 5-14). The results indicate that exposure to the average concentrations of chemicals detected at the CBU Drum Storage Area also represent a potential risk to this predator.

No HIs > 1 were generated for the maximum or average exposure scenarios using acute benchmark toxicity values for the red-tailed hawk (Appendix I.1). This indicates insignificant potential acute risks to this receptor.

5.7.6 Uncertainties

As discussed in Section 3.4, the following conservative assumptions were maintained in performing this ecological risk assessment:

- the site use factor was assumed to equal 100% (i.e., the organisms were assumed to live and forage exclusively within the boundaries of this site),
- minimum body weights were used to calculate receptor dose
- maximum ingestion rates were used to calculate receptor dose
- contaminants were assumed to be 100% biologically available
- the most sensitive life stage was assumed to be exposed to site contaminants
- it was assumed that only contaminated prey were consumed.

By adopting these conservative assumptions, the final risk estimates are deliberately conservative and are likely to overestimate the actual risk associated with contaminants detected at the CBU Drum Storage Area. This approach was taken so it may be concluded with confidence that certain chemicals detected at this site are unlikely to represent an ecological risk. While this process serves to significantly reduce the uncertainty associated with eliminating certain chemicals from further consideration, uncertainty is associated with concluding that exposure to the remaining chemicals are adversely impacting ecological receptors. An analysis of the uncertainty associated with the risk assessment process is important in that it identifies, and, to the extent possible, quantifies the uncertainty associated the entire process (problem formulation, data analysis and risk characterization). The uncertainty introduced into the risk assessment process stems from three sources: 1) imperfect knowledge of things that should be known, 2) systematic errors (e.g., computational, data, or analytical transformation errors), and 3) nonsystematic errors (i.e., random or stochastic errors) and variability in the system being assessed (Solomon et. al, 1996). A detailed discussion of uncertainties associated with the assessment process is contained in Section 3.4. This section focuses on uncertainties and assumptions that should be considered when interpreting the results of the ecological risk assessment performed at the CBU Drum Storage Area.

As noted above, it was conservatively assumed that the site use factors for both the shrew and the red-tailed hawk equaled 100%. The lack of desirable habitat, the areal extent of the CBU Drum Storage Area (approximately 0.0042 ha) represents 4.2% and 0.01% of the shrew and the red-tailed hawk. When the size of the CBU Drum Storage Area is used to adjust the HIs calculated for the hawk, the resulting values are substantially less than 1.0, suggesting that these receptors are unlikely to be adversely impacted by site contaminants. When the areal extent of the CBU Drum Storage Area is factored into the HI calculations for

the short tailed shrew, the resulting HIs are approximately an order of magnitude lower than the original HIs calculated for this receptor. Although still greater than 1.0, the likelihood that this site represents a risk to this receptor and other small mammals is unlikely. The choice of the shrew as a representative for other small mammals is conservative. Because of its very high metabolic rate, this species expends a great deal of effort foraging for food. Therefore, its contact with and incidental ingestion of soil is greater than that of other small mammals. Furthermore, because of the compacted nature of the soil and the limited cover, it is unlikely that the shrew or other species would forage in this area. Therefore, although the HI values for the shrew exceed 1.0, the potential contact with site contaminants is limited.

Uncertainty is also associated with characterizing the toxicity of contaminants detected at this site. Of these contaminants, it was determined that aluminum contributed most significantly to the potential risks calculated for terrestrial vegetation. According to Will and Suter (1994), aluminum exerts a toxic response in terrestrial vegetation by interfering with cellular division in roots, decreasing root respiration, binds with phosphorus so that it is not biologically available, interferes with the uptake of essential nutrients (calcium, magnesium, phosphorus) and water, and disrupts enzyme activity. Seedlings are more susceptible to the effects of aluminum toxicity than are older plants (Will and Suter, 1994).

The aluminum benchmark value used to determine if this metal represented a potential risk to terrestrial vegetation was taken from Will and Suter (1994). The benchmark is based on the results of a single study that documented a 30% reduction in white clover seedling establishment when 50 mg/kg aluminum was added to a sandy loam soil with a pH of 5.0. Because only a single study describing the phytotoxicity of aluminum could be identified, the confidence in this benchmark, and therefore the conclusions regarding the potential impacts of aluminum on vegetation within the CBU Drum Storage Area, is limited.

Uncertainty is also associated with the biological availability of soil organic contaminants. None of the soil samples collected from this site were analyzed for TOC. In the absence of site-specific data, the concentration of TOC measured in a sample collected from the Rubble Fill Area at Bunker A86 (TOC = 13,100 mg/kg) was used to predict concentrations of organic contaminants present in soil pore water at the CBU Drum Storage Area. It is not known if this value over or under represents actual TOC concentrations at this site. The use of a TOC value from the Rubble Fill Area at Bunker A86 also introduces uncertainty with respect to how well the predicted earthworm BAFs for soil organics represent actual BAFs. TOC is one of the parameters used to calculate earthworm BAFs for organic contaminants.

The results of the risk assessment determined that copper represented a risk to soil invertebrates associated with this site. As noted in section 5.7.5.2, copper represents one of a handful of contaminants whose impact

on soil invertebrates has been relatively well-documented. However, although the risk assessment indicated that this contaminant represented a potential risk to these receptors, additional site-specific data (e.g., soil toxicity tests) would be necessary to reduce the uncertainty associated with concluding that this contaminant is biologically available in concentrations that would adversely impact these receptors.

The risk assessment determined that vanadium contributed most significantly to the HI calculated for the short-tailed shrew (Tables 5-13 and 5-14). Vanadium is the 21st most abundant metal in the earth's crust and is a natural component of fuel oils. In addition, vanadium is commonly employed as an alloying agent by the steel industry and as a catalyst in the chemical industry (Ellenhorn and Barceloux, 1988). Vanadium appears to help regulate the Na^+/K^+ ATPase pump. The physiological mechanism associated with this metal's toxicity is unknown but is believed to be associated with its inhibition of oxidative phosphorylation (Ellenhorn and Barceloux, 1988). Vanadium compounds are poorly absorbed through the gastrointestinal wall. This information indicates that the assumption that 100% of the vanadium consumed by shrews at the CBU Drum Storage Area was absorbed is overly conservative.

As summarized in Table 3-17, the endpoint (NOAEL) used to assess risks to mammals associated with exposure to vanadium was based on a study summarized in Opresko et. al (1994). This study reported the results of a laboratory toxicity test conducted on female rats exposed to three doses of vanadium in the form of metavanadate (41.78% V) administered via oral intubation. This method of administration introduces uncertainty to these test results in that it does not represent a natural means of exposure.

The study performed on the female rats extended through 60 days prior to gestation and through gestation, delivery, and lactation. The results of the test therefore represent the effects of long term chronic exposure and are consistent with the assumption that exposure to site contaminants is also probably chronic. Because significant differences in reproductive effects were observed at all three administered doses, the lowest dose used in the study was selected as the LOAEL. The resulting LOAEL values were converted to NOAEL values by multiplying by 0.1. The lack of a NOAEL also introduces uncertainty to these test results.

Unlike the shrew, DDTR, rather than vanadium, accounted for almost all of the potential risks to the red-tailed hawk associated with the CBU Drum Storage Area (see Tables 5-13 and 5-14). DDTR manifests its toxic effect by affecting the nervous system and as a hepatotoxin. Its affect on avian reproduction (i.e., egg shell thinning) is also well known. As summarized in Appendix H, long-term dietary exposure to 2.8 to 3.0 mg/kg (wet weight) results in adverse reproductive effects in mallards, screech owls, and black ducks.

The LOAEL for the brown pelican, as reported by Anderson et. al (1975), served as the basis for developing NOAELs for the red-tailed hawk. According to USEPA (1993), this study was deemed most appropriate for the development of avian wildlife criteria for the Great Lakes because: "it represented a peer-reviewed field study that provided a chemical-specific dose-response curve for reproductive success". A UF of $4.00E-02$ was applied to the brown pelican LOAEL ($2.80E-03$ mg/kg/day), resulting in a NOAEL of $1.12E-04$ mg/kg/day for the red-tailed hawk. As noted by USEPA (1993), piscivorous (fish-eating) birds such as the brown pelican are among the avian species most severely affected by DDTR. Because development of wildlife criteria protective of piscivorous birds was among the goals of the Great Lakes Initiative, use of these data were particularly appropriate. However, the red-tailed hawk is not piscivorous. Therefore, employing the LOAEL generated for the brown pelican probably results in an overly conservative NOAEL for these two species. LOAELs reported for mallards provide some indication of the conservative nature of the value ($1.12 E-04$ mg/kg/day) used to characterize risks to the red-tailed hawk. LOAELs for this species ranged from 0.58 to 2.91 mg/kg/day (USEPA, 1993). Using a UF of $2.00E-01$ to convert from LOAELs to NOAELs produces mallard NOAELs that range from 0.116 to 0.582 mg/kg/day. While no similar DDTR toxicity data were identified for the red-tailed hawk, results of a study conducted on the American kestrel (LOAEL = 0.39 mg/kg/day; Peakall et. al, 1973) were reported. This species, like the red-tailed hawk, feeds on small mammals, rather than fish. When a UF of $4.00E-02$ is used to account for taxonomic differences between kestrels and hawks and to convert from a LOAEL to a NOAEL, a NOAEL of $1.56E-02$ mg/kg/day is generated for the red-tailed hawk. This value is substantially higher (less conservative) than the brown pelican NOAEL used to assess risks to avian receptors associated with DDTR detected at the CBU Drum Storage Area and provides an indication of the conservative nature associated with the original set of HI calculations completed for this receptor. It is probable that risks to this receptor are relatively minor.

5.8 COMPARISON OF SITE DATA TO CONNECTICUT STANDARDS

Analytical data for the CBU Drum Storage Area were compared to Connecticut drinking water standards and remediation standards (CTDEP, January 1996). Tables summarizing the comparison of site data to Connecticut standards are provided in Appendix F.4. These tables, which follow the quantitative risk assessment spreadsheets in the cited appendix, identify, on a media-specific basis, those chemicals detected at concentrations in excess of state criteria. Maximum and average chemical concentrations are presented in the summary tables. Although the maximum concentration of a chemical may exceed an associated state criteria, the distribution of the chemical in the medium is also important with respect to decision making. Therefore, the average chemical concentration was included to provide some information

on the potential distribution of the chemical. A brief narrative of the findings of this qualitative analysis is provided in the remainder of this section.

Site-specific soil data were compared to Connecticut remediation standards for direct exposure and pollutant mobility. Based on conversations with the State, USEPA, and Navy (October 25, 1995e), an industrial land use scenario is considered to be the most likely exposure scenario for the site. The following chemicals were found at maximum concentrations exceeding the state remediation standard for direct exposure under industrial land use:

- Benzo(a)pyrene
- Arsenic
- TPH

To address concerns regarding migration of chemicals from soil to groundwater, site soil data were compared to Connecticut remediation standards for pollutant mobility. The groundwater classification for the CBU Drum Storage Area is GB, which indicates that although the State recognizes that groundwater may not meet GA criteria at this time, the goal is to restore groundwater to GA quality. The list of chemicals reported at maximum concentrations exceeding the GB pollutant mobility criteria consists of:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dieldrin
- Heptachlor epoxide
- Lead
- TPH

As indicated, TCLP analytical results for lead exceeded GB pollutant mobility criteria. A qualitative evaluation of the TCLP analytical results for the site soil samples (in relation to state pollutant mobility criteria for inorganics and PCBs) is provided in Table 5-4.

Analytical groundwater data for the site were compared to Connecticut MCLs and remediation standards for groundwater and surface water protection. Sodium was detected at a maximum concentration of 28.2 mg/L, which slightly exceeded the 28 mg/L state Notification Level. No exceedances of primary MCLs were noted in the unfiltered samples. No exceedances of state MCLs were observed in the filtered samples.

Maximum concentrations for all chemicals detected in the unfiltered and filtered groundwater samples were less than the Connecticut remediation standards for groundwater protection. It should be noted that the groundwater protection criteria are applicable for GA or GAA designated groundwater and are also used to protect existing groundwater regardless of the classification.

Since groundwater at the CBU Drum Storage Area eventually discharges to a surface water body (i.e., Thames River), site-specific groundwater data were also compared to Connecticut remediation standards for surface water protection. Phenanthrene (unfiltered sample matrix) and arsenic (filtered sample matrix) were the only chemicals found at maximum concentrations exceeding the surface water protection criteria.

5.9 SUMMARY AND CONCLUSIONS

This section presents a summary of major findings for the CBU Drum Storage Area. A summary of the nature and extent of contamination is provided in Section 5.9.1. Sections 5.9.2 and 5.9.3 summarize the baseline human health risk assessment and the ecological risk assessment for the site, respectively. Section 5.9.4 summarizes the comparison of site data to state standards and Section 5.9.5 provides recommendations regarding additional action or investigatory efforts for the site.

5.9.1 Nature and Extent of Contamination

Various organic and inorganic chemicals were detected in soil and groundwater samples collected at the CBU Drum Storage Area site. For the most part, the concentrations encountered were relatively low. For example, although various volatile organics were detected in the soil, the concentrations were all less than 400 $\mu\text{g}/\text{kg}$. The concentrations of semivolatile organics were somewhat higher, particularly those of several PAHs, such as fluoranthene with a maximum concentration of 16,000 $\mu\text{g}/\text{kg}$. Other chemicals detected in the soil matrix included relatively immobile compounds such as 4,4'-DDT (3,900 $\mu\text{g}/\text{kg}$), Aroclor-1248 (420 $\mu\text{g}/\text{kg}$), and Aroclor-1254 (360 $\mu\text{g}/\text{kg}$). Inorganic chemicals were detected in the soil samples in excess of NSB-NLON background levels.

Two unfiltered groundwater samples collected from one well at the CBU Drum Storage Area contained various organic compounds including chlorobenzene, xylenes, 4-methylphenol, diethylphthalate, various PAHs. Concentrations of these chemicals were all less than 31 $\mu\text{g}/\text{L}$. Various inorganics were also detected in the filtered and unfiltered groundwater samples.

Based on the available analytical results, it is concluded that although some contamination exists at the CBU Drum Storage Area, it is essentially negligible. The groundwater sample results indicate that the chemicals in soil at the site (which are primarily immobile compounds such as PAHs, pesticides, and PCBs) have not impacted the groundwater.

5.9.2 Baseline Human Health Risk Assessment

The CBU Drum Storage Area is a relatively isolated site and the baseline human health risk assessment focused on exposure scenarios for an older child trespasser and a construction worker. Given current and anticipated future land and water use, these receptor groups are considered appropriate for the site. All of the noncarcinogenic risks (HIs) for these receptor groups were below unity. Incremental lifetime cancer risks were either less than 1E-6 or well within the USEPA's target acceptable risk range. Therefore, it is concluded that the site poses minimal risk to human health.

5.9.3 Baseline Ecological Risk Assessment

The CBU Drum Storage Area is currently characterized by compacted soil that supports limited vegetation and provides no habitat for ecological receptors. Using the conservative assumptions discussed in Section 3.4.4.2, maximum concentrations of contaminants detected in site surface soils (0 to 2 feet) were compared to benchmark values protective of various terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. When the risks associated with the average surface soil concentrations were evaluated, risks to these receptors were reduced but still exceeded 1.0. However, because of the current site conditions, actual risks to ecological receptors are likely to be much less than those calculated for this area. Areas bordering the CBU Drum Storage Area (e.g., the wooded hillside) do represent desirable habitat for wildlife. Organisms inhabiting this area may come in contact with soil contaminants associated with the site while moving through the area to forage in the nearby Area A Wetland or Area A Downstream Watercourses. While potentially exposed to soil contaminants, this exposure is much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby reducing the actual ecological risks associated with this site. The site is relatively small in aerial extent and is characterized by compacted soil which limits the available habitat to ecological receptors. In addition, this site is to be capped as part of the Area A Landfill interim remedial action (see Section 5.6.2); capping the CBU Drum Storage Area will eliminate the possibility that ecological receptors will come in contact with site contaminants. When the current and future site conditions are factored into this evaluation, it is concluded that the CBU Drum Storage Area represents little potential risk to ecological receptors.

5.9.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 5.8. Although not retained as COCs in the baseline human health risk assessment, dieldrin and heptachlor epoxide were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. This indicates that although detected concentrations were less than human health risk-based COC screening levels, these soil compounds may migrate to groundwater and potentially impact water quality.

For groundwater, minimal exceedances of state standards were observed. Sodium and phenanthrene were the only groundwater chemicals which were not selected as COCs in the baseline human health risk assessment. No dose-response parameters are available to quantitatively address exposure to these two chemicals. It should be noted that the applicable state standard for sodium is a Notification Level of a drinking water source.

5.9.5 Recommendations

It is recommended that the CBU Drum Storage Area be considered for no further action based on the following information:

- The potential source of contamination which was discovered during the 1982 IAS (26 55-gallon drums containing waste oil, lube oil, and paint materials) has been removed and no visual evidence of contamination remains at the site.
- Soil and groundwater samples collected in the vicinity of the site yielded, for the most part, relatively low concentrations of chemicals. Volatile organic compounds were detected in soil samples at concentrations less than or equal to 380 $\mu\text{g/kg}$. Only two volatile organic compounds (chlorobenzene and total xylenes) were detected in groundwater at concentrations of 12 and 24 $\mu\text{g/L}$, respectively. All semivolatile organics compounds in groundwater were detected at concentrations less than or equal to 31 $\mu\text{g/L}$.
- The human health risk assessment concluded that carcinogenic risks were all within USEPA acceptable risk range of $1\text{E-}4$ to $1\text{E-}6$ or below $1\text{E-}6$. Noncarcinogenic risks were below the USEPA acceptable level of one for all receptor groups.

- The potential for this site to impact ecological receptors from a realistic perspective, is low. Although the ecological risk assessment concluded that chemicals associated with this site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates; the calculations were performed using highly conservative estimates. Furthermore, the site is relatively small in aerial extent (15 feet wide, 30 feet long) and is characterized by compacted soil that supports limited vegetation and terrestrial species. Therefore, the CBU Drum Storage Area does not provide a significant habitat for ecological receptors.
- The site, which is located within the boundary of the Area A Landfill, will be covered with a low permeability cap as part of the planned interim remedial action for the Area A landfill. This cap, which is currently under construction, will eliminate the possibility of potential human and ecological exposure to soil at the site. Furthermore, the cap will minimize the amount of precipitation that could infiltrate through the soil and potentially transport contamination to the groundwater.

TABLE 5-1

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	TPH ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/PCBs ⁽¹⁾	Metals (total)	Metals/PCBs	

SOILS

1SS4C ⁽⁵⁾	0-0.5		● ⁽⁶⁾	●	●		
1SS1S	0-0.5	●				●	●
1SS1D	1-1.5	●					●
1SS2S	0-0.5					●	●
1SS2D	1-1.5	●					●
1SS3S	0-0.5					●	●
1SS3D	1-1.5	●					●

- 1 Polychlorinated biphenyls.
- 2 Target Analyte List metals plus boron and cyanide.
- 3 Toxicity Characteristic Leaching Procedure (TCLP) for metals and PCBs.
- 4 Total Petroleum Hydrocarbons.
- 5 1SS4C is a composite of 1SS1S, 1SS2S and 1SS3S.
- 6 ● - Indicates samples analyzed at fixed-base laboratory.

TABLE 5-2

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis						
		Target Compound List (TCL)				TAL Metals ⁽¹⁾		TPH ⁽³⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽²⁾	Total	Dissolved	
ROUND 1 - SOILS								
1TB1-0002	0-2	● ⁽⁴⁾	●	●	●	●		●
1TB1-0608	6-8	●	●	●	●	●		●
1TB2-1214	12-14	●	●	●	●	●		●
1TB3-0002	0-2	●	●	●	●	●		●
1TB3-0507	5-7	●	●	●	●	●		●
ROUND 1 - GROUNDWATER								
1GW2S	--	●	●	●	●	●	●	●
ROUND 2 - GROUNDWATER								
1GW2S-2	--	●	●	●	●	●	●	●

- 1 TAL Metals plus boron. Water samples were also analyzed for hardness.
- 2 Polychlorinated biphenyls.
- 3 Total Petroleum Hydrocarbons.
- 4 ● - Indicates samples analyzed at fixed-base laboratory.

TABLE 5-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS

CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	1SS1D	1SS1S	1SS2D	1SS2S	1SS3D	1SS3S	1SS4C
DEPTH (feet):	1 - 1.5	0 - 0.5	1 - 1.5	0 - 0.5	1 - 1.5	0 - 0.5	0 - 0.5
LOCATION:	1SS1	1SS1	1SS2	1SS2	1SS3	1SS3	1SS4C
SAMPLE DATE:	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	COMPOSITE
STATUS:							
VOLATILES (UG/KG)							
1,1,1-TRICHLOROETHANE	6 U	6 U	6 U		28 U		
2-BUTANONE	11 U	11 U	11 U		56 U		
ETHYLBENZENE	6 U	6 U	6 U		6 J		
METHYLENE CHLORIDE	6 U	6 U	1 J		28 U		
TETRACHLOROETHENE	6 U	6 U	6 U		28 U		
TRICHLOROETHENE	6 U	6 U	6 U		28 U		
XYLENES, TOTAL	6 U	6 U	6 U		300		
SEMIVOLATILES (UG/KG)							
1,4-DICHLOROBENZENE							2000 U
2-METHYLNAPHTHALENE							2000 U
ACENAPHTHENE							2000 U
ACENAPHTHYLENE							2000 U
ANTHRACENE							2000 U
BENZO(A)ANTHRACENE							2000 U
BENZO(A)PYRENE							2000 U
BENZO(B)FLUORANTHENE							2000 U
BENZO(G,H,I)PERYLENE							2000 U
BENZO(K)FLUORANTHENE							2000 U
BUTYL BENZYL PHTHALATE							2000 U
CHRYSENE							2000 U
DI-N-BUTYL PHTHALATE							2000 U
DIBENZO(A,H)ANTHRACENE							2000 U
DIBENZOFURAN							2000 U
FLUORANTHENE							450 J
FLUORENE							2000 U
INDENO(1,2,3-CD)PYRENE							2000 U
NAPHTHALENE							2000 U
PHENANTHRENE							2000 U
PYRENE							370 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD							55

TABLE 5-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS

CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	1SS1D	1SS1S	1SS2D	1SS2S	1SS3D	1SS3S	1SS4C
DEPTH (feet):	1 - 1.5	0 - 0.5	1 - 1.5	0 - 0.5	1 - 1.5	0 - 0.5	0 - 0.5
LOCATION:	1SS1	1SS1	1SS2	1SS2	1SS3	1SS3	1SS4C
SAMPLE DATE:	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	COMPOSITE
STATUS:							

PESTICIDES/PCBs (UG/KG)

4,4'-DDE							20 U
4,4'-DDT							20 U
ALDRIN							10 U
ALPHA-CHLORDANE							100 U
AROCLOR-1248							100 U
AROCLOR-1254							200 U
DIELDRIN							20 U
ENDRIN							20 U
GAMMA-BHC (LINDANE)							10 U
GAMMA-CHLORDANE							100 U
HEPTACHLOR							10 U
HEPTACHLOR EPOXIDE							10 U

INORGANICS (MG/KG)

ALUMINUM							8730
ANTIMONY							5.8 UR
ARSENIC							2.1
BARIUM							42.8
BERYLLIUM							0.59 J
BORON							46.0 R
CADMIUM							2.1
CALCIUM							2830
CHROMIUM							16.1
COBALT							6.8
COPPER							30.9 J
IRON							12300
LEAD							59.3
MAGNESIUM							4070
MANGANESE							228
MERCURY							0.12 U
NICKEL							13.7

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TABLE 5-3**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS****CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	1SS1D	1SS1S	1SS2D	1SS2S	1SS3D	1SS3S	1SS4C
DEPTH (feet):	1 - 1.5	0 - 0.5	1 - 1.5	0 - 0.5	1 - 1.5	0 - 0.5	0 - 0.5
LOCATION:	1SS1	1SS1	1SS2	1SS2	1SS3	1SS3	1SS4C
SAMPLE DATE:	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90	11/28/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	COMPOSITE
STATUS:							
INORGANICS (MG/KG)							
POTASSIUM							255 J
SELENIUM							0.93 J
SODIUM							93.2 J
VANADIUM							16.2
ZINC							64.9 J
TOTAL PETROLEUM HYDROCARBONS (MG/KG)							
TPH	730	130 J	140	110	9800	220	

TABLE 5-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS

CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	1TB1-0002	1TB1-0608	1TB2-1214	1TB3-0002	1TB3-0507	-	-
DEPTH (feet):	0 - 2	6 - 8	12 - 14	0 - 2	5 - 7	-	-
LOCATION:	1TB1	1TB1	1TB2	1TB3	1TB3	-	-
SAMPLE DATE:	01/18/94	01/18/94	01/12/94	01/12/94	01/12/94	//	//
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	-	-
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	-	-
STATUS:						-	-
VOLATILES (UG/KG)							
1,1,1-TRICHLOROETHANE	11 U	16 U	13 U	11 U	1 J		
2-BUTANONE	20	16	13 U	15	170 J		
ETHYLBENZENE	11 UJ	23	13 U	23 J	79 J		
METHYLENE CHLORIDE	11 U	16 U	13 U	11 U	28 J		
TETRACHLOROETHENE	11 UJ	16 U	13 U	2 J	4 J		
TRICHLOROETHENE	11 U	16 U	13 U	2 J	3 J		
XYLENES, TOTAL	38 J	97	1 J	29 J	380 J		
SEMIVOLATILES (UG/KG)							
1,4-DICHLOROBENZENE	110 J	520 U	430 U	370 U	3800 U		
2-METHYLNAPHTHALENE	2100	12000	430 U	25 J	3800 U		
ACENAPHTHENE	370 U	2800 J	430 U	370 U	240 J		
ACENAPHTHYLENE	370 U	520 UJ	430 U	35 J	3800 U		
ANTHRACENE	190 J	2800 J	430 U	86 J	500 J		
BENZO(A)ANTHRACENE	680	2300	430 U	230 J	1100 J		
BENZO(A)PYRENE	380 J	850	430 U	250 J	1100 J		
BENZO(B)FLUORANTHENE	630 J	1600	29 J	440	2200 J		
BENZO(G,H,I)PERYLENE	220 J	280 J	430 U	180 J	3800 U		
BENZO(K)FLUORANTHENE	610 J	520 U	430 U	370 U	3800 U		
BUTYL BENZYL PHTHALATE	370 U	520 U	430 U	820 J	3800 U		
CARBAZOLE	370 U	700 J	430 U	35 J	240 J		
CHRYSENE	1100	1900	430 U	290 J	1600 J		
DI-N-BUTYL PHTHALATE	970	460 J	430 U	370 U	3800 U		
DIBENZO(A,H)ANTHRACENE	370 UJ	520 U	430 U	59 J	3800 U		
DIBENZOFURAN	370 U	2500 J	430 U	24 J	3800 U		
FLUORANTHENE	1300 J	13000	42 J	650	3300 J		
FLUORENE	260 J	3600 J	430 U	43 J	300 J		
INDENO(1,2,3-CD)PYRENE	200 J	290 J	430 U	210 J	950 J		
NAPHTHALENE	930	6500	430 U	370 U	3800 U		
PHENANTHRENE	410	16000	53 J	430	2600 J		
PYRENE	1400	9000	37 J	560	2600 J		
PESTICIDES/PCBs (UG/KG)							

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TABLE 5-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS

CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	1TB1-0002	1TB1-0608	1TB2-1214	1TB3-0002	1TB3-0507	-	-
DEPTH (feet):	0 - 2	6 - 8	12 - 14	0 - 2	5 - 7	-	-
LOCATION:	1TB1	1TB1	1TB2	1TB3	1TB3	-	-
SAMPLE DATE:	01/18/94	01/18/94	01/12/94	01/12/94	01/12/94	-	-
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	-	-
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	-	-
STATUS:						-	-

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	3900	2100	24 J	37 U	38 U		
4,4'-DDE	58 J	25 J	43 UJ	37 U	38 U		
4,4'-DDT	26 J	7.9 J	140 J	37 U	38 U		
ALDRIN	19 U	2.6 J	22 UJ	19 U	20 U		
ALPHA-CHLORDANE	28	9.9 J	22 UJ	19 U	20 U		
AROCLOR-1248	370 U	520 U	430 UJ	370 U	360 J		
AROCLOR-1254	420 J	520 U	430 UJ	370 U	380 U		
DIELDRIN	29 J	31 J	43 UJ	37 U	38 U		
ENDRIN	4.1 J	3.5 J	43 UJ	37 U	38 U		
GAMMA-BHC (LINDANE)	19 U	1.8 J	22 UJ	19 U	20 U		
GAMMA-CHLORDANE	7.6 J	27 U	22 UJ	19 U	20 U		
HEPTACHLOR	19 U	3.4 J	22 UJ	19 U	20 U		
HEPTACHLOR EPOXIDE	19 U	27 J	22 UJ	19 U	20 U		

INORGANICS (MG/KG)

ALUMINUM	10100	18900	14800	7110	7760		
ANTIMONY	6.8 J	17.4 J	5.5 J	5.3 J	11.8 J		
ARSENIC	4.8	10.2	5.4	2.7 U	3.3 J		
BARIUM	75.7 J	93.9 J	51.5 J	40.7 J	78.6 J		
BERYLLIUM	1.0 J	0.87 J	0.68 J	0.36 J	1.6		
BORON	11.4 U	19.7 J	13.0 U	11.4 U	14.6 J		
CADMIUM	1.2 J	2.6 J	0.81 J	0.73 J	1.7 J		
CALCIUM	3460 J	3520 J	1760 J	4240 J	9130 J		
CHROMIUM	34.1	42.9	19.1	14.7	34.7		
COBALT	6.2 J	9.3 J	6.1 J	4.7 J	9.5 J		
COPPER	115 J	147 J	14.1 J	31.3 J	164 J		
IRON	19100	31200	15700	12000	15800		
LEAD	104	366	32.4	4.8	207		
MAGNESIUM	2880	5610	3240	2490	2680		
MANGANESE	215	290	165	166	191		
MERCURY	0.21 J	0.18 U	0.15 J	0.47	0.61		

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TABLE 5-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS

CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	1TB1-0002	1TB1-0608	1TB2-1214	1TB3-0002	1TB3-0507	-	-
DEPTH (feet):	0 - 2	6 - 8	12 - 14	0 - 2	5 - 7	-	-
LOCATION:	1TB1	1TB1	1TB2	1TB3	1TB3	-	-
SAMPLE DATE:	01/18/94	01/18/94	01/12/94	01/12/94	01/12/94	//	//
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	-	-
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	-	-
STATUS:							
INORGANICS (MG/KG)							
NICKEL	33.8	23.8 J	9.6 J	9.1 J	46.6		
POTASSIUM	1660 J	3550 J	1390 J	1750 J	1460 J		
SELENIUM	0.5 U	0.71 U	0.52 U	0.46 U	0.46 U		
SODIUM	342 J	582 J	305 J	270 J	394 J		
VANADIUM	186	55.4	30.5	19.1 J	25.9		
ZINC	460 J	134 J	67.0 J	39.6 J	709 J		
TOTAL PETROLEUM HYDROCARBONS (MG/KG)							
TPH	2570	7510	67.6	514	41		

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TABLE 5-4
**SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON, GRÖTON, CONNECTICUT**

SAMPLE NUMBER:	1SS1S	1SS2S	1SS3S				
INVESTIGATION:	PH1	PH1	PH1				
SAMPLE DATE:	11/28/90	11/28/90	11/28/90				
LOCATION:	1SS1	1SS2	1SS3				
SAMPLE TYPE:	GRAB	GRAB	GRAB				
STATUS:							
TCLP METALS (MG/L)*							
BARIUM (100.0/10.0)	0.310 J	0.220 J	0.330 J				
LEAD (5.0/0.15)	0.600	0.300 U	0.300 U				
SELENIUM (1.0/0.5)	0.0020 U	0.0021 J	0.0021 U				

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 5-5
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	SURFACE SOIL (<2 FEET)(1)			SUBSURFACE SOIL (>2 FEET)(2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
1,1,1-Trichloroethane	0/6	-	ND(3)	1/3	1	1TB3
2-Butanone	2/6	15-20	1TB1	2/3	16-170	1TB3
Ethylbenzene	2/6	6-23	1TB3	2/3	23-79	1TB3
Methylene chloride	1/6	1	1SS2	1/3	28	1TB3
Tetrachloroethene	1/6	2	1TB3	1/3	4	1TB3
Trichloroethene	1/6	2	1TB3	1/3	3	1TB3
Xylenes, total	3/6	29-300	1SS3	3/3	1-380	1TB3
SEMIVOLATILE ORGANICS (ug/kg)						
1,4-Dichlorobenzene	1/3	110	1TB1	0/3	-	ND
2-Methylnaphthalene	2/3	25-2100	1TB1	1/3	12000	1TB1
Acenaphthene	0/3	-	ND	2/3	240-2800	1TB1
Acenaphthylene	1/3	35	1TB3	0/3	-	ND
Anthracene	2/3	86-190	1TB1	2/3	500-2800	1TB1
Benzo(a)anthracene	2/3	230-680	1TB1	2/3	1100-2300	1TB1
Benzo(a)pyrene	2/3	250-380	1TB1	2/3	850-1100	1TB3
Benzo(b)fluoranthene	2/3	440-630	1TB1	3/3	29-2200	1TB3
Benzo(g,h,i)perylene	2/3	180-220	1TB1	1/3	280	1TB1
Benzo(k)fluoranthene	1/3	610	1TB1	0/3	-	ND
Butyl benzyl phthalate	1/3	820	1TB3	0/3	-	ND
Carbazole	1/2	35	1TB3	2/3	240-700	1TB1
Chrysene	2/3	290-1100	1TB1	2/3	1600-1900	1TB1
Di-n-butyl phthalate	1/3	970	1TB1	1/3	460	1TB1
Dibenzo(a,h)anthracene	1/3	59	1TB3	0/3	-	ND
Dibenzofuran	1/3	24	1TB3	1/3	2500	1TB1
Fluoranthene	3/3	450-1300	1TB1	3/3	42-13000	1TB1
Fluorene	2/3	43-260	1TB1	2/3	300-3600	1TB1
Indeno(1,2,3-cd)pyrene	2/3	200-210	1TB3	2/3	290-950	1TB3
Naphthalene	1/3	930	1TB1	1/3	6500	1TB1

TABLE 5-5
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Analyte	SURFACE SOIL (<2 FEET)(1)			SUBSURFACE SOIL (>2 FEET)(2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Phenanthrene	2/3	410-430	1TB3	3/3	53-16000	1TB1
Pyrene	3/3	370-1400	1TB1	3/3	37-9000	1TB1
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	2/3	55-3900	1TB1	2/3	24-2100	1TB1
4,4'-DDE	1/3	58	1TB1	1/3	25	1TB1
4,4'-DDT	1/3	26	1TB1	2/3	7.9-140	1TB2
Aldrin	0/3	-	ND	1/3	2.6	1TB1
Alpha-Chlordane	1/3	28	1TB1	1/3	9.9	1TB1
Aroclor-1248	0/3	-	ND	1/3	360	1TB3
Aroclor-1254	1/3	420	1TB1	0/3	-	ND
Dieldrin	1/3	29	1TB1	1/3	31	1TB1
Endrin	1/3	4.1	1TB1	1/3	3.5	1TB1
Gamma-BHC (lindane)	0/3	-	ND	1/3	1.8	1TB1
Gamma-Chlordane	1/3	7.6	1TB1	0/3	-	ND
Heptachlor	0/3	-	ND	1/3	3.4	1TB1
Heptachlor epoxide	0/3	-	ND	1/3	27	1TB1
INORGANICS (mg/kg)						
Aluminum	3/3	7110-10100	1TB1	3/3	7760-18900	1TB1
Antimony	2/2	5.3-6.8	1TB1	3/3	5.5-17.4	1TB1
Arsenic	2/3	2.1-4.8	1TB1	3/3	3.3-10.2	1TB1
Barium	3/3	40.7-75.7	1TB1	3/3	51.5-93.9	1TB1
Beryllium	3/3	0.36-1	1TB1	3/3	0.68-1.6	1TB3
Boron	0/2	-	ND	2/3	14.6-19.7	1TB1
Cadmium	3/3	0.73-2.1	1SS4C	3/3	0.81-2.6	1TB1
Calcium	3/3	2830-4240	1TB3	3/3	1760-9130	1TB3
Chromium	3/3	14.7-34.1	1TB1	3/3	19.1-42.9	1TB1
Cobalt	3/3	4.7-6.8	1SS4C	3/3	6.1-9.5	1TB3
Copper	3/3	30.9-115	1TB1	3/3	14.1-164	1TB3
Iron	3/3	12000-19100	1TB1	3/3	15700-31200	1TB1

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TABLE 5-5
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Analyte	SURFACE SOIL (<2 FEET)(1)			SUBSURFACE SOIL (>2 FEET)(2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Lead	3/3	4.8-104	1TB1	3/3	32.4-366	1TB1
Magnesium	3/3	2490-4070	1SS4C	3/3	2680-5610	1TB1
Manganese	3/3	166-228	1SS4C	3/3	165-290	1TB1
Mercury	2/3	0.21-0.47	1TB3	2/3	0.15-0.61	1TB3
Nickel	3/3	9.1-33.8	1TB1	3/3	9.6-46.6	1TB3
Potassium	3/3	255-1750	1TB3	3/3	1390-3550	1TB1
Selenium	1/3	0.93	1SS4C	0/3	-	ND
Sodium	3/3	93.2-342	1TB1	3/3	305-582	1TB1
Vanadium	3/3	16.2-186	1TB1	3/3	25.9-55.4	1TB1
Zinc	3/3	39.6-460	1TB1	3/3	67-709	1TB3
TCLP (mg/L)(4)						
Barium (100.0/1.0)	3/3	0.22-0.33	1SS3	-	-	NA(5)
Lead (5.0/0.015)	1/3	0.6	1SS1	-	-	NA
Selenium (1.0/0.05)	1/3	0.0021	1SS2	-	-	NA
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	8/8	110-9800	1SS3	3/3	41-7510	1TB1

- 1 Includes samples 1SS1S, 1SS1D, 1SS2S, 1SS2D, 1SS3S, 1SS3D, 1SS4C, 1TB1-0002, 1TB3-0002.
- 2 Includes samples 1TB1-0608, 1TB2-1214, and 1TB3-0507.
- 3 ND - Not Detected.
- 4 Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/
Connecticut Clean-up Standard Pollutant Mobility Criteria for GA/GAA Waters.
- 5 NA - Not Analyzed.

TABLE 5-6

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	1GW2S	1GW2S	1GW2S-2	1GW2S-2			
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2			
SAMPLE DATE:	03/20/94	03/20/94	06/26/94	06/26/94	//	//	//
LOCATION:	1MW2S	1MW2S	1MW2S	1MW2S			
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow			
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered			
VOLATILES (UG/L)							
CHLOROBENZENE	12		10 U				
XYLENES, TOTAL	24		10 U				
SEMIVOLATILES (UG/L)							
2-METHYLNAPHTHALENE	1 J		12				
4-METHYLPHENOL	1 J		0.6 J				
ACENAPHTHENE	2 J		8 J				
ANTHRACENE	1 J		3 J				
CARBAZOLE	7 J		19				
DI-N-BUTYL PHTHALATE	10 U		0.6 J				
DIBENZOFURAN	2 J		13				
DIETHYL PHTHALATE	1 J		1 J				
FLUORANTHENE	10 U		3 J				
FLUORENE	2 J		13				
NAPHTHALENE	9 J		31				
PHENANTHRENE	4 J		22				
PYRENE	10 U		1 J				
INORGANICS (UG/L)							
ALUMINUM	132 U	66.0 U	94.9	22.7 U			
ARSENIC	2.4 J	4.0 J	3.5	4.4			
BARIUM	35.5 J	32.1	92.5	90.6			
BORON	54.5 J	57.1 J	130	112			
CALCIUM	29900	29600	68500	67700			
CHROMIUM	4.5 U	3.0 U	1.6 J	3.0 U			
IRON	13400	13300	27600	27100			
MAGNESIUM	4290	4320	5400	5220			
MANGANESE	409	406	527	520			
POTASSIUM	3490	2940	3930	4060			
SILVER	2.0 UJ	3.9 U	1.0 U	2.2			
SODIUM	17400	17900	28300	27500			

TABLE 5-6
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	1GW2S	1GW2S	1GW2S-2	1GW2S-2			
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2			
SAMPLE DATE:	03/20/94	03/20/94	06/26/94	06/26/94	//	//	//
LOCATION:	1MW2S	1MW2S	1MW2S	1MW2S			
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow			
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered			
INORGANICS (UG/L)							
ZINC	9.8 U	12.4	8.0	2.8			
TOTAL PETROLEUM HYDROCARBONS (UG/L)							
TPH	500 U		1200				
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃	96		180				

TABLE 5-7

CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration ⁽¹⁾		
	Surface Soil (mg/kg)	All Soil (mg/kg)	Groundwater (mg/L)
Chlorobenzene	NA ⁽²⁾	NA	0.009 ⁽³⁾
Benzo(a)anthracene	NA	1.1/2.3	NA
Benzo(b)fluoranthene	NA	1.2/2.2	NA
Benzo(a)pyrene	0.32/0.38	0.65/1.1	NA
Carbazole	NA	NA	0.013 ⁽³⁾
Indeno(1,2,3-cd)pyrene	NA	0.41/0.95	NA
4,4'-DDD	2.0/3.9	1.5/3.9	NA
Aroclors	0.30/0.42	0.51/0.78	NA
Antimony	6.1/6.8	10.3/17.4	NA
Arsenic	3.1/4.8	4.9/10.2	0.0030 ⁽³⁾
Beryllium	0.68/1.0	0.96/1.6	NA
Chromium	NA	31.6/42.9	NA
Manganese	191/215	216/290	0.468 ⁽³⁾
Vanadium	103/186	71.6/186	NA

- 1 UCL if single concentration presented, otherwise average for CTE and maximum for RME. For groundwater, maximum is defined as the highest average concentration in a single well and average is defined as the overall average concentration of all well-specific averages.
- 2 NA - Not applicable. Chemical is not a chemical of concern for this medium.
- 3 Maximum. Average exceeds maximum.

TABLE 5-8

ESTIMATED RISKS⁽¹⁾
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Hazard Index				Incremental Cancer Risk			
	Older Child Trespasser		Construction Worker		Older Child Trespasser		Construction Worker	
	RME ⁽²⁾	CTE ⁽³⁾	RME	CTE	RME	CTE	RME	CTE
Incidental Ingestion of Soil	6.8E-2	5.3E-3	2.1E-1	3.5E-2	1.8E-6	3.8E-8	6.6E-7	1.0E-7
Dermal Contact with Soil ⁽⁴⁾	3.0E-2	9.4E-4	4.2E-2	1.8E-3	1.8E-7	8.1E-10	2.4E-8	5.2E-10
Dermal Contact with Groundwater	NA ⁽⁵⁾	NA	1.0E-1	6.9E-2	NA	NA	3.3E-8	2.2E-8
Cumulative Risk:	9.8E-2	6.2E-3	3.5E-1	1.1E-1	2.0E-6	3.9E-8	6.8E-7	1.0E-7

- 1 Chemical-specific risks presented in Appendix F.4.
- 2 RME - Reasonable Maximum Exposure.
- 3 CTE - Central Tendency Exposure.
- 4 Quantitative evaluation performed for cadmium, PCBs, and dioxins (if detected).
- 5 NA - Not applicable; exposure route not evaluated for this receptor.

TABLE 5-9
ECOLOGICAL CHEMICALS OF CONCERN
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Terrestrial Vegetation ^(1,2)		Soil Invertebrates		Short-Tailed Shrew		Red-Tailed Hawk	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
Phenanthrene	NA	NA	NA	NA	X	X	NA	NA
4,4'-DDD	NA	NA	NA	NA	X	X	X	X
4,4'-DDE	NA	NA	NA	NA	NA	NA	X	X
4,4'-DDT	NA	NA	NA	NA	NA	NA	X	X
Aroclor-1254	NA	NA	NA	NA	X	X	NA	NA
Aluminum	X	X	NA	NA	NA	NA	NA	NA
Antimony	X	X	NA	NA	X	X	X	X
Arsenic	NA	NA	NA	NA	X	NA	NA	NA
Barium	NA	NA	NA	NA	X	NA	NA	NA
Beryllium	NA	NA	NA	NA	X	NA	NA	NA
Cadmium	NA	NA	NA	NA	X	X	NA	NA
Chromium	X	X	X	NA	X	X	NA	NA
Copper	NA	NA	X	NA	X	NA	NA	NA
Lead	X	X	X	NA	X	X	NA	NA
Manganese	NA	NA	NA	NA	X	NA	NA	NA
Mercury	X	X	NA	NA	NA	NA	NA	NA
Nickel	X	NA	NA	NA	NA	NA	NA	NA
Vanadium	X	X	X	NA	X	X	NA	NA
Zinc	X	X	NA	NA	X	NA	X	X

Notes 1) NA - not applicable. Chemical is not chemical of concern for this receptor.
2) X - Chemical of concern for this receptor.

TABLE 5-10

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MAXIMUM CONCENTRATIONS
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	2.0E+2
Vanadium	9.3E+1
Chromium	3.4E+1
Zinc	9.2E+0
Lead	2.1E+0
Mercury	1.6E+0
Antimony	1.4E+0
Copper	1.2E+0
Nickel	1.1E+0

TABLE 5-11

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MEAN CONCENTRATIONS
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	1.7E+2
Vanadium	5.2E+1
Chromium	2.4E+1
Zinc	5.0E+0
Antimony	1.2E+0
Lead	1.1E+0
Mercury	1.1E+0

TABLE 5-12

HAZARD QUOTIENTS FOR SOIL INVERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Copper	3.8E+0
Lead	1.8E+0
Chromium	1.4E+0

TABLE 5-13

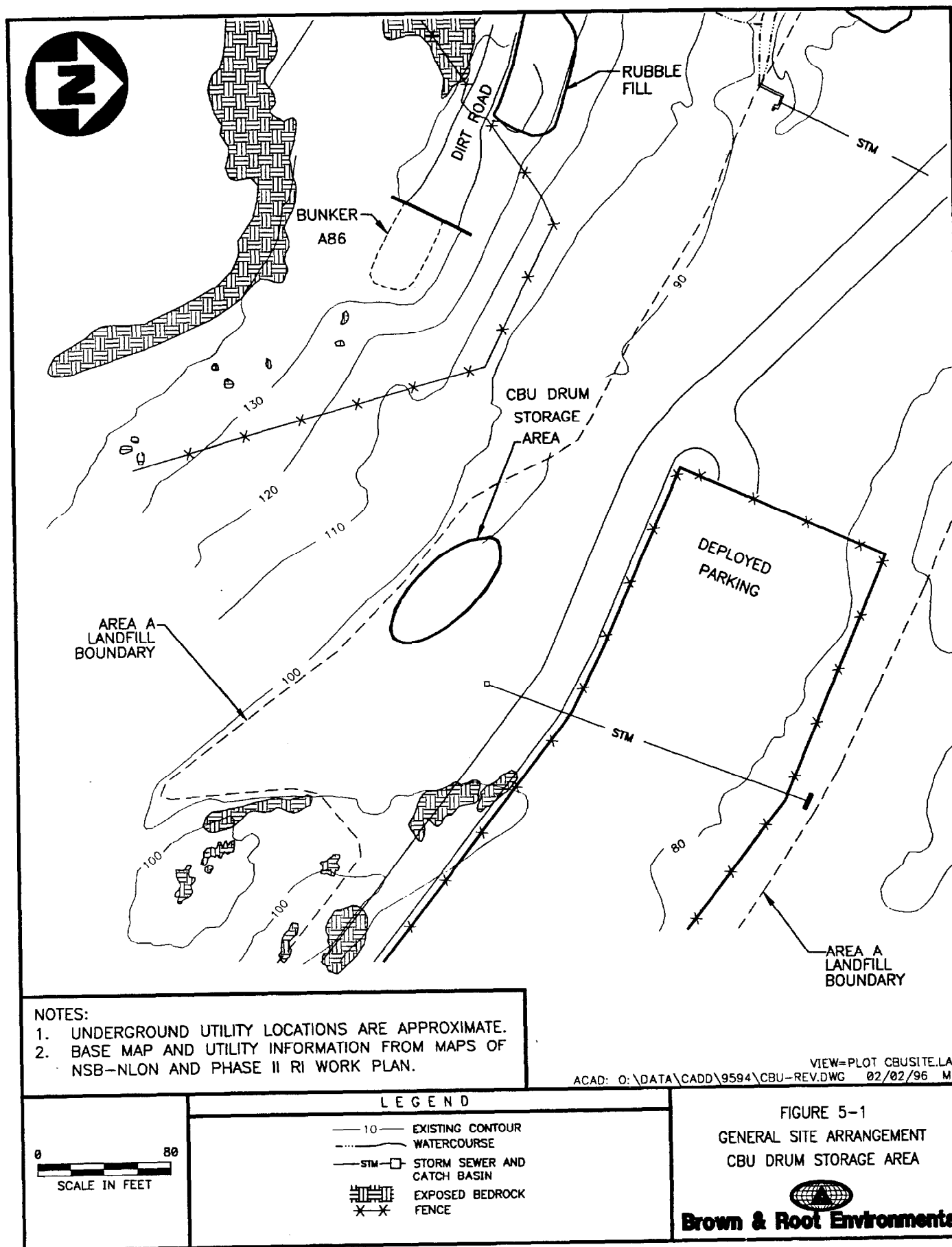
MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 1 - CBU DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

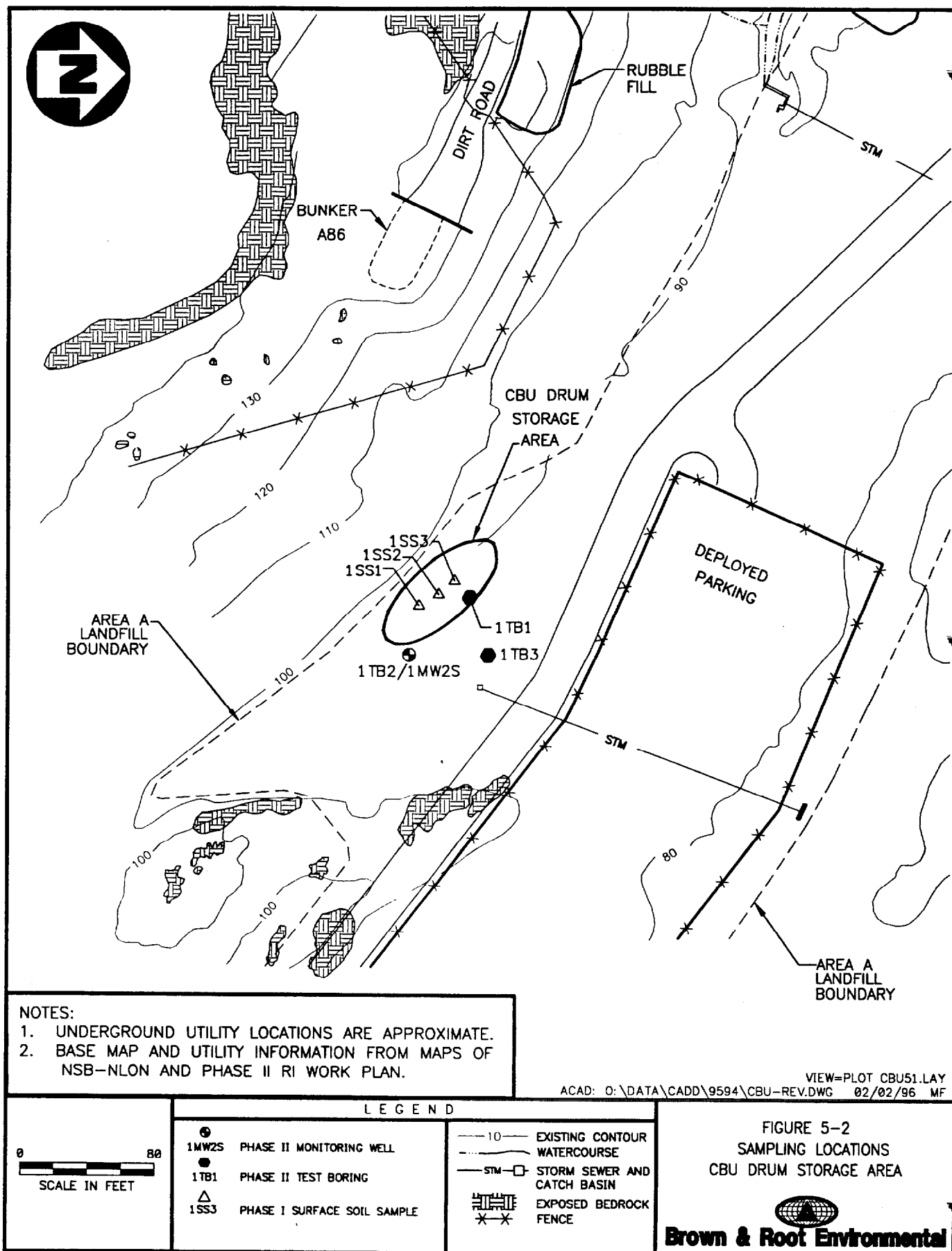
Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Vanadium	4.0E+2	63.2
	Antimony	1.2E+2	19.4
	Chromium	3.3E+1	5.3
	Arsenic	1.7E+1	2.7
	All others	5.9E+1	9.4
	Total Receptor HI	6.3E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	3.7E+2	58.4
	Food	2.6E+2	41.6
	Water	0.0E+0	0.0
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	4,4'-DDD	4.2E+2	96.4
	4,4'-DDE	6.3E+0	1.4
	4,4'-DDT	2.8E+0	0.6
Red-Tailed Hawk	Antimony	2.8E+0	0.6
	All others	4.2E+0	1.0
	Total Receptor HI	4.4E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	7.6E+1	17.2
	Food	3.6E+2	82.8
	Water	0.0E+0	0.0

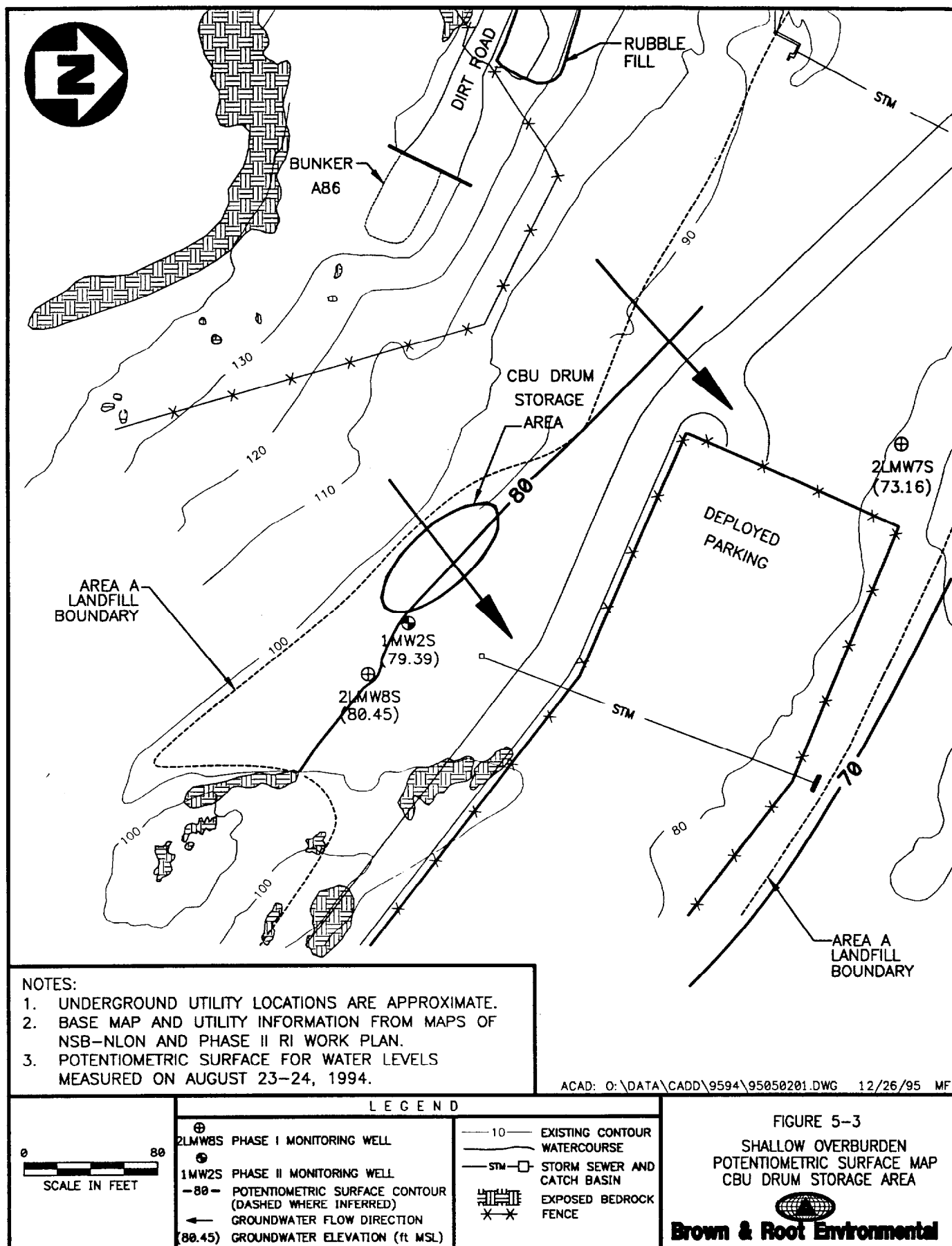
TABLE 5-14

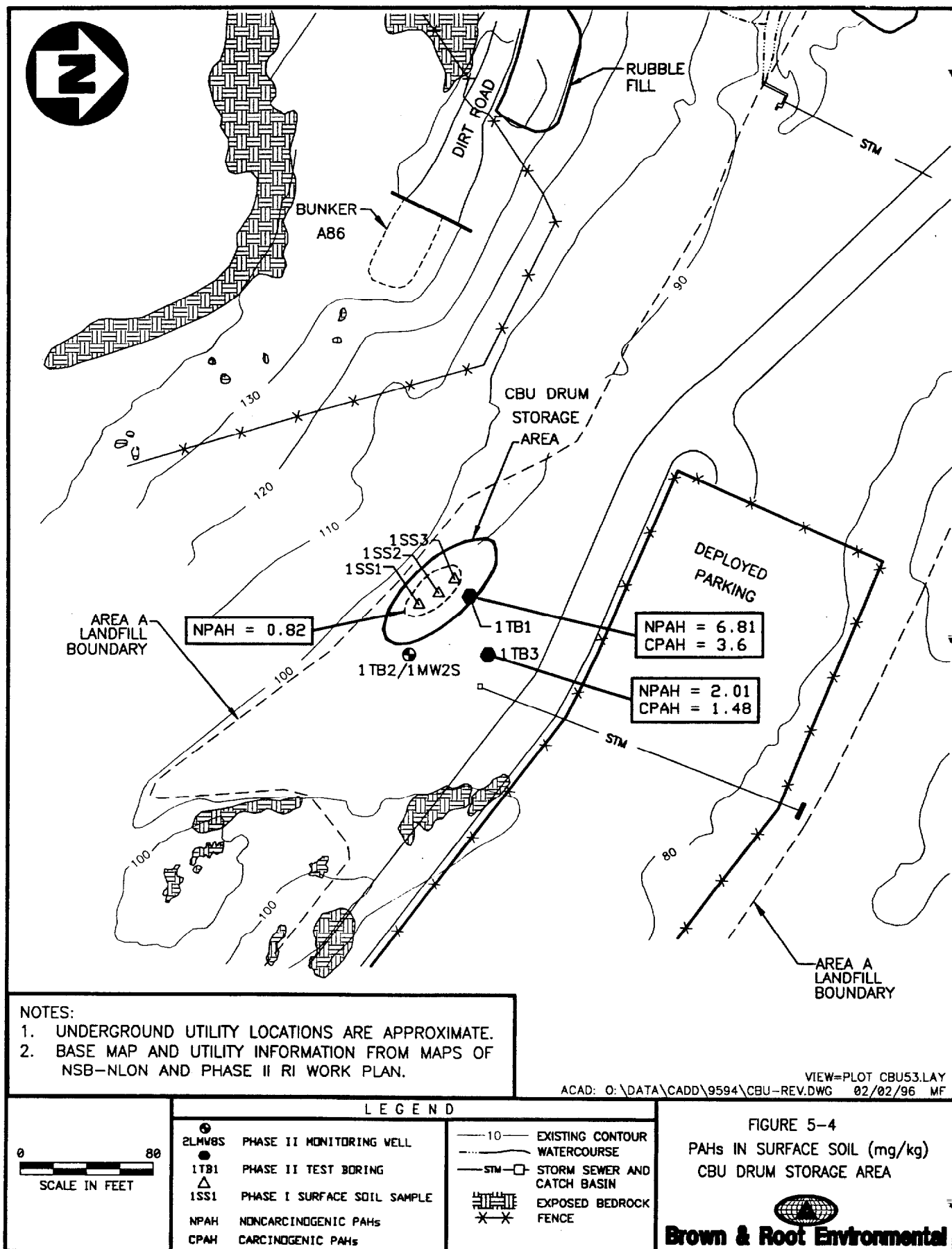
MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 1 - CONSTRUCTION BATTALION UNIT DRUM STORAGE AREA
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Vanadium	2.2E+2	58.8
	Antimony	1.1E+2	29.0
	Chromium	2.4E+1	6.4
	Lead	6.7E+0	1.8
	All others	1.5E+1	4.0
	Total Receptor HI	3.7E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	2.2E+2	58.3
	Food	1.5E+2	41.7
	Water	0.0E+0	0.0
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	4,4'-DDD	2.1E+2	95.0
	4,4'-DDE	4.2E+0	1.8
	Antimony	2.5E+0	1.1
Red-Tailed Hawk	4,4'-DDT	2.4E+0	1.1
	All others	2.2E+0	1.0
	Total Receptor HI	2.2E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	3.9E+1	17.6
	Food	1.8E+2	82.4
	Water	0.0E+0	0.0









6.0 AREA A LANDFILL - SITE 2

This section provides a site-specific summary of various aspects of the Area A Landfill investigation. Section 6.1 provides a brief site description. The sampling and analysis program is summarized in Section 6.2. Section 6.3 discusses site physical features. The nature and extent of contamination is discussed in Section 6.4. Contaminant fate and transport is summarized in Section 6.5. Section 6.6 provides the baseline human health risk assessment and Section 6.7 provides the ecological risk assessment, and Section 6.8 includes a comparison to state standards. Section 6.9 provides a summary and conclusions.

6.1 SITE DESCRIPTION

The Area A Landfill is located in the northeastern and north-central section of NSB-NLON and encompasses approximately 13 acres. The general configuration of the Area A Landfill and adjacent sites is shown on Figure 6-1. The location of the Area A Landfill is shown on Drawing 1 (Volume III). Access to the landfill is via a dirt road off Wahoo Avenue. The thickness of the landfill materials is estimated to be 10 to 20 feet based on test boring data. The Area A Landfill is a relatively flat area bordered by a steep, wooded hillside that rises to the south, a steep wooded ravine to the west, and the Area A Wetland to the north. Aerial photographs show that the landfill appears to extend east along the wetland as far as a recreational area (tennis courts). A review of aerial photographs also appears to indicate that the most filling occurred within the eastern and western limits of the landfill. Current photographs of the site are included in Appendix B.3.

According to the IAS report, the landfill opened sometime before 1957. However, a 1957 aerial photograph shows no apparent landfilling which may indicate a somewhat later startup date. All materials generated by base operations that were not salvageable were incinerated, and the residues were disposed in the Goss Cove and Area A Landfills. The base incinerator, which was located north of the Lower Subbase along the waterfront at the present location of Building 478, ceased operation in 1963. From 1963 to 1973 all refuse and debris were disposed in the Area A Landfill. As reported in Section 5.2.1 of Volume I of the draft Historical Radiological Assessment (HRA), on-site disposal of solid radioactive waste attributed to the Naval Nuclear Propulsion Program (NNPP) has been prohibited since the inception of the Program. Based on records, established policy, and interviews, the potential for NNPP radioactive material having been disposed onsite is considered to be effectively zero. The possibility of general radioactive material (G-RAM) having been disposed onsite is addressed in Section 5.2.3, page 5-6, of draft HRA Volume II: "Although unlikely, given what is known about the material used for fill, small amounts of G-RAM incorporated in consumer

products (e.g., radioluminescent exit signs, smoke detectors, etc.) could have been disposed with other industrial material in the DRMO, Area A Landfill, or Goss Cove Landfill areas." It is not expected that the potential for G-RAM radioactivity in these former landfills would vary substantially from that in commercial landfills operated for typical civilian use.

The area fill method was reportedly used in landfill operations. New refuse was dumped from the face of previously deposited refuse and covered with earth. The cover material used on the landfill was sand and gravel obtained from the Groton water supply reservoir. Landfilling operations ceased in 1973. After closure, a concrete pad was constructed in the southwest portion of the landfill for above-ground storage of industrial wastes. The pad is still in existence and is located adjacent and to the northeast of Building 373, and south of the dirt road that extends through this area. At the time of the IAS, 42 steel drums, 87 transformers (mineral oil and PCB), and 60 to 80 electrical switches were stored on the pad. Two transformers and several electrical switches were reportedly leaking. Past leakage of oil was also evident. Most drums were stacked on wooden pallets and those having PCB labels were covered and bound with plastic sheeting. All of these materials have since been properly disposed off site.

The IAS report also indicated that refuse, including steel drums, oxygen candles, wood and metal scrap, concrete, and tires, was exposed at the edge of the landfill adjacent to the wetland. The IAS report stated that petroleum compounds had recently been poured from containers and had flowed into the wetland at two locations (northwestern portions of the landfill). The IAS report also stated that when batteries were overhauled, spent sulfuric acid solution was transferred to barrels and transported to Area A for disposal. The acid was poured into trenches dug with a bulldozer and subsequently covered with soil.

Atlantic personnel performed an inspection of the Area A Landfill on September 30, 1988. Orange leachate was observed along the toe of the slope of the landfill extending from the dike to the east end of the deployed parking lot. The slope of the landfill had been covered with fill, and material in the landfill was not visible.

Sand bags, salt, and contractors' supplies and equipment are stored at the former landfill. Several transformers, removed underground storage tanks, crane weights, and other equipment were previously stored on the concrete pad in the southwest portion of the landfill. The remainder of the landfill is not paved. The construction of a paved parking lot on the southeast end of the Area A Landfill was planned but has been delayed indefinitely.

A low permeability cap will be installed on the Area A Landfill as an interim remedial action for soils at the site. The cap would consist of a bedding / gas management layer underlying a double liner, a drainage

layer above the double liner, and an operating surface in selected areas at the top. The remedial action would also include the installation of a surface water and groundwater interception trench along the southern border (upgradient) of the site. A toe drain may also be installed along the interface of the Area A landfill and the Area A Wetland to stabilize the cap and to intercept shallow groundwater before discharging to the Area A Wetland.

Pre-design study activities are currently being conducted to determine the extent of the area to be capped, and to determine if a leachate collection system is needed.

6.2 SITE INVESTIGATIONS

Section 2.0 includes a detailed discussion of the sampling procedures and analytical methods employed during the investigations at NSB-NLON. Sample locations (Phase I RI, Phase II RI, and FFS) are depicted on Figures 6-2 and 6-3. The remainder of this section summarizes the scope of the Phase I RI, Phase II RI, and FFS investigations.

6.2.1 Phase I RI

The Phase I RI of the Area A Landfill consisted of test borings, monitoring well installation, and soil and groundwater sampling. Nine subsurface soil samples (greater than 2 feet deep) plus one field duplicate were collected from one test boring and seven monitoring well borings at the site. Five surface soil samples (less than 2 feet deep) plus one field duplicate were also collected and analyzed. Landfill materials were encountered during drilling, generally to an average depth of 10 to 12 feet. Landfill materials encountered included glass, brick, wood, plastic, and ash, intermixed with sand and gravel material used as cover. Twelve groundwater samples (plus two field duplicates) were collected from five shallow and twelve deep monitoring wells. Sample locations are shown on Figures 6-2 and 6-3. Table 6-1 displays a sample-specific summary of the sampling and analysis program for the Phase I RI.

6.2.2 Phase II RI

During the 1994 Phase II RI, soil samples were collected from two test borings located near Building 373. Each of the three surface and seven subsurface samples collected from these borings was analyzed for PCBs using a field gas chromatograph. One surface and one subsurface sample were also analyzed for dioxins (fixed-base laboratory). Twenty-seven groundwater samples were collected in March, 1994 during Round 1 of the Phase II RI groundwater sampling; 5 samples were collected from newly installed wells and 22 samples were obtained from wells installed during previous investigations. Eight of the groundwater

samples were collected during a 4-day pumping test, as described in Section 2-2, from well 2LPW1S. Eight of these wells were sampled during a second groundwater sampling event in August, 1994 for a total of 14 samples plus one field duplicate. Sample locations are shown on Figures 6-2 and 6-3. Table 6-2 presents a sample-specific summary of the sampling and analysis program for the Phase II RI.

6.2.3 Focused Feasibility Study

Ten surface soil samples (plus one field duplicate) and ten subsurface soil samples (plus two field duplicates) were initially collected during the Focused Feasibility Study (FFS). Three additional subsurface soil samples (LF-SB03, LF-SB04, and LF-SB05) were collected in a supplemental sampling round to support the FFS. Samples of the concrete pad were also collected during the FFS from four areas where evidence of staining was observed. Sample locations are shown on Figures 6-2 and 6-3. Table 6-3 presents a sample-specific summary of the sampling and analysis program for the FFS.

6.3 PHYSICAL CHARACTERISTICS

This section presents a summary of site physical characteristics for the Area A Landfill based on information generated during the Phase I and Phase II RIs. Topography and surface features, surface water, soils, geology, and hydrogeology are discussed in the subsections that follow.

6.3.1 Topography and Surface Features

Figure 6-1 shows the topography and surface features of the Area A Landfill and adjacent sites, including the Area A Wetland and Area A Weapons Center. The ground surface slopes gently across the Area A Landfill toward the Area A Wetland. A steep hillside (central bedrock high) borders the southern edge of the landfill. The CBU Drum Storage Area is located south and on the upgradient edge of the western portion of the landfill. Near the northwestern edge of the landfill, the ground surface drops along a steep ravine and dike to the OBDA. The ground surface increases in elevation to the northeast from the tennis courts to Route 12 and Baldwin Hill. The ground surface elevation across the landfill from upgradient to downgradient edge ranges from approximately 90 to 80 feet msl. Adjacent to the toe of the landfill, the Area A Wetland ground surface is at an elevation of approximately 72 feet msl.

Sand and gravel was used as cover material for the Area A Landfill. A concrete pad is located in the southwest portion of the site and is adjacent to Building 373 and south of the dirt entrance road. The remainder of the landfill is not paved. A gravel parking lot is located in the central portion of the landfill

(deployed parking). A paved parking lot was planned for construction at the southeast end of the landfill. However, construction of the parking lot has been delayed indefinitely.

6.3.2 Surface Water Features (Atlantic, August 1992)

Runoff from the Area A landfill drains as overland flow north into the Area A Wetland, which subsequently discharges to the Area A Downstream Watercourses and ultimately into the Thames River.

6.3.3 Soil Characteristics

The SCS Soils Map (SCS, 1983) classifies the soil at most of the Area A Landfill as Udorthents-Urban land. This soil type is defined as excessively drained to moderately drained soils that have been disturbed by cutting and filling. Along the southwestern slope of the landfill and in upgradient areas, the soil is classified as the Hollis-Charlton-Rock complex. Stones and boulders are intermingled with a dark, fine, sandy loam. Bedrock outcrops are prevalent in the area.

6.3.4 Geology

The Area A Landfill contains 10 to 20 feet of miscellaneous fill that consists of fine- to coarse-grained sand and gravel as well as refuse including ash, wood fragments, paper, brick fragments, and asphalt. The fill is generally underlain by 10 to 20 feet of dredge spoil. Where no dredge spoil underlies the fill material, the fill material directly overlies a thin alluvial layer or the bedrock surface. Dredge spoil is encountered mainly beneath the easternmost portion of the landfill. Along the southeastern border of the landfill, the fill material is underlain by an alluvial layer, consisting of silty sand. The alluvial layer is underlain by gravel and gneiss boulders. Boulders were also identified outside of the eastern edge of the landfill at well cluster 2LMW19. The bedrock surface across the Area A Landfill is depicted on Drawing 4 (Volume III). Geologic conditions are shown on cross-sections E-E' and G-G' on Drawings 19 and 20, respectively (Volume III).

The bedrock beneath the Area A Landfill has been identified as the biotite-quartz-feldspar gneiss of the Mamacoke Formation. Quartzite was identified at a depth of 80 feet in the 2LMW20D boring log. This is consistent with the existence of quartzite layers within the Mamacoke Formation. The bedrock surface slopes to the northeast towards the Area A Wetland from the large central bedrock high in the center of the facility. The landfill is situated along the flank of the bedrock ridge such that the depth to bedrock increases to the northeast. In the western portion of the site, the landfill is situated immediately adjacent to the hillside and the depth to bedrock is typically less than 20 feet, whereas in the eastern portion the landfill is located

further out from the hillside and the depth to bedrock increases to 70 feet. There appears to be a localized bedrock depression at 2LMW8D; however, there are insufficient data to verify the extent of the depression.

6.3.5 Hydrogeology

Groundwater was encountered within the dredge spoil, alluvium, and bedrock underlying the Area A Landfill. In some areas, the bottom portion of the fill materials are also below the water table. Depth to groundwater averages about 10 feet across the landfill. The saturated thickness of the overburden materials ranges from less than 10 feet to at least 65 feet across the landfill.

Figure 6-4 shows shallow overburden groundwater contours across the Area A Landfill, Area A Wetland, and Area A Weapons Center site map. Groundwater flows northeast across most of the Area A Landfill, from the topographic/bedrock high to the Area A Wetland. Figure 6-5 shows bedrock groundwater flow contours for the same area. Both maps show a similar groundwater flow pattern, indicating an overall hydraulic connection between the two units. Upward groundwater gradients from the bedrock to the overburden/fill are predominant, although a downward gradient exists at the 2LMW18 well cluster, the bedrock elevation is lower and the overburden is thicker. Hydraulic potentials between the bedrock and overburden groundwater at the 2LMW7, 2LMW8, 2LMW17, 2LMW18, and 2LMW20 well clusters differ by 3 to 7 feet. This suggests that although groundwater flow directions in the bedrock and overburden are similar, the degree of hydraulic connection varies spatially and there is restriction of flow between the overburden and bedrock in some areas.

East of the Area A Landfill, near the 2LMW19 and 2WMW3 well clusters, local groundwater flow is to the north and west into the Area A Wetland. Groundwater elevations in the bedrock and overburden are similar, and vertical gradients are minimal.

In the western portion of the Area A Landfill near the dike, groundwater flows to the northwest toward the Area A Downstream Watercourses. At the 2LMW9 well cluster, the groundwater elevation in the overburden is relatively high, presumably as a result of the presence of the dike acting as a damming effect on the shallow groundwater. In the bedrock, the groundwater potential is significantly lower when compared to the groundwater potential in other bedrock wells at the Area A Landfill, reflecting a hydraulic connection and flow to the Area A Downstream Watercourses.

This abnormally low bedrock groundwater potential may be hydraulically connected to a groundwater discharge seep that is present at the toe of the OBDA. The seep, which is located at an elevation that would correspond with groundwater to the bedrock, may be acting to dewater the local bedrock.

Cross-section G-G' shows the groundwater flow directions from the bedrock high (4MW4 well cluster) northeast toward the Area A Wetland and northwest toward the Area A Downstream Watercourses. Cross-section E-E' shows the groundwater flow from the Area A Landfill toward the Area A Wetland.

A pumping test was performed using well 2LPW1S as a pumping well. Results from the test are presented in Table 4-2 (Section 4.6.2). Estimated hydraulic conductivities based on the pumping test are 3.5 feet/day ($1.2\text{E-}3$ cm/sec) at 2LOW1S and 2.1 feet/day ($7.4\text{E-}4$ cm/sec) at well 2LOW2S. The geometric mean of these two values is 2.7 feet/day ($9.5\text{E-}4$ cm/sec). Slug tests performed during the Phase I RI indicate that the hydraulic conductivity for the combined fill material and dredge spoil was 3.2 feet/day ($1.1\text{E-}3$ cm/sec). The estimated hydraulic conductivity for the dredge spoil alone was 1.0 feet/day ($3.5\text{E-}4$ cm/sec). This hydraulic conductivity testing data suggests that the dredge spoils have a somewhat lower hydraulic conductivity than the fill materials.

Based on the August 1993 round of water level measurements, the hydraulic gradient across the landfill in the overburden is 0.033. The geometric mean hydraulic conductivity is 2.7 feet/day (Table 4-3). Assuming a 30 percent effective porosity, the average seepage velocity is estimated at 0.3 feet/day.

6.3.6 Ecological Habitat

The Area A Landfill presents a generally inhospitable environment due to its gravel cover, the pavement covering the concrete pad and proximity to areas of high human activity (e.g., the Area A Weapons Center). However, the Area A Landfill does border areas that do represent potential wildlife habitat. A steep, wooded hillside rises to the south of the landfill, a steep wooded ravine is located immediately to the west, and the Area A Wetland is located to the north (BRE, February 1995). While the Area A Wetland does provide cover and potential habitat, the wetland is dominated by *Phragmites* sp., which limits the wetland's habitat value to wildlife. The hillside and the ravine south of the Area A Landfill is characterized as upland deciduous forest. Species dominating these areas include red/black oak, black birch, red maple, mockernut hickory, sassafras, mountain laurel, and witch hazel (Atlantic, 1992).

6.4 NATURE AND EXTENT OF CONTAMINATION

This section contains a discussion of the nature and extent of contamination at the Area A Landfill. The chemical analytical results from both the Phase I and Phase II RIs and the FFS are summarized in this section. The complete data base is contained in Appendix D.2.

6.4.1 Soil

Positive results for all soil samples are presented in Table 6-4. TCLP results are presented in Table 6-5. The analytical results are summarized in Table 6-6.

A few volatile organic compounds, including two ketones, four monocyclic aromatics, and three halogenated aliphatics were infrequently detected in surface soil samples. Sample 2LSS1 (0-6 inches), collected from an area about 200 feet east of Building 373 and adjacent to the northeast corner of the concrete pad, contained high concentrations of three monocyclic aromatic hydrocarbons (ethylbenzene at a concentration of 14,000 $\mu\text{g/kg}$, xylenes at 75,000 $\mu\text{g/kg}$, and chlorobenzene at 4,500 $\mu\text{g/kg}$). These results may indicate the possible occurrence of a recent spill. These compounds were not prevalent in the groundwater samples collected in the area, as discussed in the next section. With the exception of chlorobenzene (43 $\mu\text{g/kg}$) in sample 2LSS2, all other volatile compounds were detected at concentrations of 16 $\mu\text{g/kg}$ or less.

Several PAHs were detected in from one to eight surface soil samples, with pyrene being detected most frequently and at the highest concentration (1,100 $\mu\text{g/kg}$ in 2LSS2). Maximum concentrations for seven of nine PAHs were found in sample 2LMW9. Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were also each detected in one sample.

Surface soil sample 2LSS2 contained relatively high concentrations of 4,4'-DDT (2,300 $\mu\text{g/kg}$) and Aroclor-1260 (12,000 $\mu\text{g/kg}$) as well as endrin ketone (570 $\mu\text{g/kg}$). Aroclor-1260 and 4,4'-DDT were detected in from two to six additional samples at concentrations ranging from 230 $\mu\text{g/kg}$ to 350 $\mu\text{g/kg}$ and from 6.8 $\mu\text{g/kg}$ to 110 $\mu\text{g/kg}$, respectively. Several other pesticides and PCBs, with concentrations ranging from 0.56 $\mu\text{g/kg}$ to 490 $\mu\text{g/kg}$, were also detected in from one to seven of the surface soil samples.

Octachlorodibenzo-p-dioxin (OCDD) was detected in surface soil sample 2LTB13-0001 (2.5 $\mu\text{g/kg}$), collected during Round 2 of Phase I, and again in surface soil sample 2LTB13(0-2) (1.592 $\mu\text{g/kg}$), collected during the FFS. No other dioxins or furans were detected in the surface soil samples.

Several metals were detected at concentrations greater than NSB-NLON background in the surface soils. Some of the most notable exceedances were copper, lead, nickel, and zinc, all of which were found at maximum concentrations approximately an order of magnitude greater than the representative background concentrations. No consistent pattern of metals contamination was evident; the maximum concentrations of metals in the surface soils were found in samples collected from several different locations.

Arsenic, barium, cadmium, chromium, lead, and selenium were detected in the TCLP leachates of surface soil samples, with maximum concentrations most often found in the leachate of sample 2LTB18. (Of the surface soil samples analyzed for TCLP metals, sample 2LTB18 generally also contained the highest concentrations of metals prior to TCLP extraction.) Maximum concentrations of all TCLP metals were below Federal Toxicity Characteristic Regulatory Levels, but several concentrations of cadmium and lead exceeded Connecticut remediation standards for pollutant mobility for GB waters.

Figure 6-6 provides a graphic presentation of concentrations of fuel-related compounds (toluene, ethylbenzene, and xylenes), 4,4'-DDT and its related pesticides, total PCBs, and represent entire metals (lead, copper, and zinc) detected in surface soil samples.

Several volatile organic compounds were detected in subsurface soil samples. Four monocyclic aromatic compounds were detected at relatively high concentrations in the 4- to 8-foot deep sample from boring 2LTB23 (chlorobenzene at 4,500 $\mu\text{g/kg}$, ethylbenzene at 28,000 $\mu\text{g/kg}$, toluene at 3,200 $\mu\text{g/kg}$, and xylenes at 140,000 $\mu\text{g/kg}$). The boring is located near the east side of the concrete pad. With the exception of chlorobenzene, these monocyclic aromatics were also detected at substantially lower concentrations in from four to seven other subsurface soil samples. Ethylbenzene and xylenes were detected in the subsurface soil sample from boring 2LTB20, located approximately 30 feet northeast of Building 373, at concentrations of 7,700 $\mu\text{g/kg}$ and 8,800 $\mu\text{g/kg}$, respectively. Concentrations of ethylbenzene in the remaining subsurface soil samples ranged from 15 $\mu\text{g/kg}$ to 68 $\mu\text{g/kg}$; concentrations of toluene ranged from 6 $\mu\text{g/kg}$ to 27 $\mu\text{g/kg}$; and concentrations of xylenes ranged from 4 $\mu\text{g/kg}$ to 690 $\mu\text{g/kg}$. 1,1,2,2-Tetrachloroethane, 1,1,2-trichloroethane, and trichloroethene were each detected in subsurface soil sample 2LMW14S at concentrations of 22 $\mu\text{g/kg}$ or less. 4-Methyl-2-pentanone and carbon disulfide were detected in subsurface soil sample 2LMW18S at concentrations of 12 $\mu\text{g/kg}$ or less. Carbon disulfide was also detected in subsurface soil sample LF-SB03 at 8 $\mu\text{g/kg}$. Acetone and methylene chloride were also detected in a few subsurface soil samples.

Several of the subsurface soil samples also contained PAHs, with a majority of the maxima found in sample 2LTB20. Maximum concentrations of PAHs ranged from 220 $\mu\text{g/kg}$ to 61,000 $\mu\text{g/kg}$ (phenanthrene). 2,4-Dimethylphenol, 4-methylphenol, bis(2-ethylhexyl)phthalate, carbazole, and di-n-butyl phthalate were also detected in from one to five samples.

Several pesticides and PCBs were detected in subsurface soil samples, with 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and Aroclor-1254 being detected most frequently. Many of the maximum concentrations were detected in

samples 2LTB23 and 2LTB29 (located approximately 40 and 80 feet, respectively, east of the concrete pad) with concentrations as high as 100,000 $\mu\text{g/kg}$ (Aroclor-1254 in 2LTB23).

OCDD was detected at a concentration of 1.7 $\mu\text{g/kg}$ in the subsurface soil sample 2LTB23-0406, collected during Round 1 of the Phase II RI. OCDD (1.626 $\mu\text{g/kg}$) as well as three furans (1,2,3,4,6,7,8-HpCDF at 0.246 $\mu\text{g/kg}$, 1,2,3,4,7,8-HxCDF at 0.306 $\mu\text{g/kg}$, 1,2,3,6,7,8-HxCDF at 0.153 $\mu\text{g/kg}$) were detected in subsurface soil sample 2LTB23 (4-8) collected during the FFS.

The highest concentrations of half of the detected metals were found in the subsurface soil sample 2LTB22 (6 to 8 feet). The boring log indicates that this sample was collected in fill material. Concentrations of most metals exceeded background with several metals, including antimony, barium, boron, chromium, cobalt, copper, lead, mercury, nickel, silver, and zinc, exceeding background by more than an order of magnitude.

No pesticides were detected in the TCLP extracts of subsurface soil samples. Several metals were detected in TCLP extracts of subsurface soil samples. All maximum concentrations were below the Federal toxicity characteristic regulatory levels. Cadmium and lead, however, were detected at concentrations that exceeded the Connecticut remediation standards for pollutant mobility.

Figure 6-7 provides a graphic presentation of concentrations of fuel-related compounds (toluene, ethylbenzene, and xylenes), 4,4'-DDT and its related compounds, total PCBs, total carcinogenic and total noncarcinogenic PAHs, and representative metals (lead, copper, manganese, and zinc) were detected in subsurface soil samples.

6.4.2 Pavement

Positive results for the four pavement samples are provided in Table 6-7. The results are summarized on Table 6-8.

Several pesticides and Aroclor-1260 were detected in the pavement samples. Heptachlor epoxide was detected in all four samples, and DDT and endrin were both detected in all samples except 2LC2. The remaining pesticides and Aroclor-1260 were each detected in one or two samples. Sample 2LC3 contained the maximum concentrations of most pesticides including DDT (550 $\mu\text{g/kg}$), alpha-BHC (21 $\mu\text{g/kg}$), dieldrin (160 $\mu\text{g/kg}$), endosulfan II (440 $\mu\text{g/kg}$), endosulfan I (78 $\mu\text{g/kg}$), endrin (15 $\mu\text{g/kg}$), endrin ketone (130 $\mu\text{g/kg}$), and heptachlor epoxide (330 $\mu\text{g/kg}$). Aroclor-1260 was detected in samples 2LC2 and 2LC4

at concentrations of 490 $\mu\text{g/kg}$ and 340 $\mu\text{g/kg}$, respectively. All other detections of pesticides/PCBs were at concentrations of 12 $\mu\text{g/kg}$ or less.

6.4.3 Groundwater

Positive analytical results for all groundwater samples are presented in Table 6-9. Results for the Phase I RI samples are summarized in Table 6-10; results for samples collected during Rounds 1 and 2 of the Phase II RI are summarized in Tables 6-11 and 6-12, respectively.

Various organics were detected in the Phase I RI groundwater samples. The highest concentrations were detected in the sample collected from shallow well 2LMW18S, which is located in the central portion of the landfill. This sample contained 9.5 $\mu\text{g/L}$ benzene, 180 $\mu\text{g/L}$ chlorobenzene, 115 $\mu\text{g/L}$ ethylbenzene, 730 $\mu\text{g/L}$ xylenes, as well as various dichlorobenzene isomers, three phenols, 1,2,4-trichlorobenzene, two phthalate esters, two relatively soluble PAHs (naphthalene and 2-methylnaphthalene) and Aroclor-1254 (140 $\mu\text{g/L}$). Benzoic acid (4 $\mu\text{g/L}$) was also detected in one shallow well (2LGW9S). Deep well 2LMW13D, which is located near the northern edge of the landfill, contained three volatile organic chemicals (1,1,2,2-tetrachloroethane (140 $\mu\text{g/L}$), 1,2-dichloroethene (1 $\mu\text{g/L}$), and trichloroethene (10 $\mu\text{g/L}$), and deep well 2LMW18D contained bis(2-ethylhexyl)phthalate (6 $\mu\text{g/L}$). No other organic compounds were detected in the deep wells. Maximum concentrations of most metals in shallow wells were also found in well 2LGW18S, while maxima in deep wells were most often found in wells 2LGW9D and 2LGW14D.

Based on the levels of uncertainty reported with results (i.e., uncertainty levels are greater than results themselves) for gross alpha in all shallow well samples except 2LMW17S and for gross beta in sample 2LMW17S, gross alpha and gross beta are considered as not detected in these samples. Likewise, gross alpha is considered as not detected in all deep well samples except 2LMW9D, 2LMW13D, and 2LMW17D, and gross beta is considered as not detected in sample 2LMW8D. With this in mind, gross alpha was detected at 3.3 pCi/L in sample 2LMW17S, and gross beta was detected in shallow well samples at concentrations ranging from 3.7 pCi/L to 54.05 pCi/L. Gross alpha was detected at concentrations ranging from 2.9 pCi/L to 17.9 pCi/L in deep well samples, while gross beta was detected in deep well samples at concentrations ranging from 3.7 pCi/L to 24.1 pCi/L. Maximum concentrations for gross alpha and gross beta in deep well samples were both found in sample 2LMW13D.

During Rounds 1 and 2 of the Phase II RI, the sample from shallow well 2LMW18S again showed the highest concentrations of volatile organics (monocyclic aromatics). The sample from deep well 2LMW13D contained the same halogenated aliphatic compounds as were detected during the Phase I RI, although the

concentrations generally decreased by about 50 percent. A few additional volatiles were also detected in the Phase II RI samples. The Phase II Round 1 and Round 2 groundwater sample results are fairly consistent for volatile organics.

The wells sampled during the Phase II RI contained several semivolatile organic compounds at moderate concentrations. The maximum concentration of semivolatile organics detected in the deep well samples during Round 1 was 2 $\mu\text{g/L}$ (di-n-octylphthalate and benzoic acid). The phthalate esters were detected at higher concentrations in Round 2. Although a few additional semivolatile organic compounds were detected in the shallow wells during Round 2, the concentrations were similar to those reported in Round 1. Maximum concentrations of semivolatiles in shallow wells were found once again in 2LGW18S during Rounds 1 and 2. The sample from well 2LMW18S also contained 710 $\mu\text{g/L}$ Aroclor-1260, (Round 1) and 7.5 $\mu\text{g/L}$ Aroclor-1016 and 290 $\mu\text{g/L}$ Aroclor-1260 (Round 2). Locations of maximum concentrations of semivolatiles varied among deep wells; several more semivolatiles were detected in deep wells during both of the Phase II RI sampling rounds than were detected during the Phase I RI. In addition, the concentrations of most metals were generally lower in the deeper wells than in the corresponding shallow wells during both rounds.

The only radionuclide identified by complete gamma spectrum analysis was naturally occurring potassium-40. Once again, based on the levels of uncertainty reported with results, gross alpha in shallow well sample 2LGW7S-2 and potassium-40 in shallow well sample 2LGW18S-2 (both Phase II RI, Round 2 samples) are considered as not detected in these samples. Therefore, gross alpha was detected in samples 2LGW9D (7 pCi/L) and 2LGW13D (12 pCi/L) during Round 1 and in samples 2LGW9D-2 (6 pCi/L) and 2LGW18S-2 (11 pCi/L) during Round 2. Gross beta was detected in all four samples analyzed during both Rounds 1 and 2; the results seemed to follow no particular pattern. Potassium-40 was detected at concentrations of 250 pCi/L (Round 1) and 130 pCi/L (Round 2) in shallow samples collected from well 2LMW7S.

Most of the wells at this site do not exhibit significant levels of contamination. The presence of contamination appears to center around wells 2LMW13D and 2LMW18S, which are located in two entirely different areas of the landfill.

As indicated by Table 6-7, results for samples 2LPW1S-1 through 2LP1S-8, collected from well 2LPW1 during the pumping test, were generally consistent. 4-Methyl-2-pentanone, ethylbenzene, toluene, and xylenes were detected at similar concentrations in all samples, while methylene chloride was detected in four of eight samples. While benzoic acid (13 $\mu\text{g/L}$) was detected in only the first of three samples analyzed for semivolatiles, 2-methylnaphthalene and acenaphthene were detected in two to three samples at

concentrations of 1 $\mu\text{g/L}$ or less. Two phenols were also detected at concentrations less than 0.8 $\mu\text{g/L}$ in the last of three samples. Results for metals were also consistent among the three samples analyzed for metals.

6.5 CONTAMINANT FATE AND TRANSPORT

The analytical data for the samples collected at this site indicate that some vertical contaminant transport may have occurred. However, since many of the contaminants observed in the subsurface soil are relatively insoluble (e.g., PAHs, Aroclors, DDT, and OCDD), it is possible that the contamination at depth reflects not transport but rather successive emplacement of waste and soil.

A well located in the central portion of the Area A Landfill (well 2LMW18S) contained several monocyclic aromatics, which are very soluble relative to PAHs, etc. However, these compounds were not present at high concentrations in the soil. The suite of contaminants found in this sample may indicate a prior spill followed by vertical migration to the water table. The types of compounds detected are typical of those found in fuels.

Other wells located near Building 373 also contained several volatile organic compounds (the halogenated aliphatics). These compounds are also fairly soluble and when spilled may migrate vertically through the soil column. Once in the groundwater, monocyclic aromatics and halogenated aliphatics will migrate downgradient at a rate determined by the amount of organic carbon in the soil matrix (the retardation factor) and the interstitial pore velocity of the groundwater.

The two areas of contamination identified in the groundwater (centering around wells 2LMW18S and 2LMW13D) are not apparently related either spatially or in the types of chemicals observed. In both areas, the concentrations have reduced since they were first sampled in 1990, indicating potential migration from these areas.

4,4'-DDT and its metabolites occur in both the surface and subsurface soil. This may indicate that the 4,4'-DDT is degrading as would be expected. The presence of these pesticides in the subsurface soil may indicate that spraying occurred while the Area A Landfill was active, and may not be indicative of vertical transport of these highly sorptive compounds.

6.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the results of the site-specific risk assessment performed for potential soil and groundwater exposures at the Area A Landfill. The risk assessment is based on exposure scenarios that were defined in Section 3.3.3. All calculations are contained in Appendix F.5.

6.6.1 Data Evaluation

A number of chemicals of concern (COCs) were selected at this site for both soil and groundwater, based on a comparison of site data to the risk-based COC screening levels described in Section 3.3.1. All data collected during the Phase I and II RIs and the FFS, except data from soil samples obtained from depths greater than 10 feet and the pavement samples (2LC1 through 2LC4), were used to identify COCs. Appendix F.5 contains the COC summary screening tables for the Area A Landfill.

The types of chemicals present at maximum concentrations that exceeded the risk-based COC screening levels for residential soil ingestion were as follows:

- PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene).
- 4,4'-DDT.
- PCBs (Aroclor-1242, -1248, 1254, and 1260).
- Dioxins (1,2,3,4,7,8- and 1,2,3,6,7,8-HxCDF).
- Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, vanadium, and zinc).

Dioxins and several PAHs and metals (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, antimony, barium, chromium, mercury, nickel, and vanadium) were retained as COCs for "all soil" (soil from depths of 0 to 10 feet) only. Maximum detections of these compounds in the surface soil samples were less than the COC screening level.

As presented in the site-specific COC summary screening tables (in Appendix F.5), maximum soil detections were also compared to USEPA Soil Screening Levels (SSLs) for migration to groundwater. Maximums detections for several chemicals (1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chlorobenzene,

ethylbenzene, methylenechloride, xylenes, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, carbazole, chrysene, 4,4'-DDT, dieldrin, endrin, heptachlor, barium, cadmium, chromium, mercury, and nickel) detected in the site soil samples exceeded the SSLs, indicating the potential for these chemicals to migrate to groundwater and potentially impact water quality.

COCs for groundwater were selected using unfiltered and filtered site groundwater samples from shallow and deep wells and the risk-based screening levels for residential groundwater use. This approach results in a conservative list of COCs for groundwater since 1) groundwater at the site is not expected to be used as a potable water supply under potential future land use conditions and 2) dermal contact with shallow groundwater during construction activities is the only anticipated exposure to this medium.

The following COCs were identified for groundwater:

- Monocyclic aromatics (benzene, chlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene).
- Halogenated aliphatic hydrocarbons (chloroform, methylene chloride, 1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene).
- Bis(2-ethylhexyl)phthalate.
- 4-Methylphenol.
- PCBs (Aroclor-1016, -1254, and 1260).
- Metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, lead, manganese, nickel, thallium, and vanadium).

Of these chemicals, benzene, chlorobenzene, methylene chloride, trichloroethene, 1,2,4-trichlorobenzene, bis(2-ethylhexyl)phthalate, PCBs, antimony, beryllium, cadmium, chromium, lead, and thallium were detected at maximum concentrations in excess of primary drinking water standards. Several organic chemicals (2-methylnaphthalene, acenaphthylene, benzo(g,h,i)perylene, phenanthrene, 2-methylphenol, 4-chloro-3-methylphenol, endrin aldehyde, and endrin ketone) and some inorganic essential human nutrients (calcium, magnesium, potassium, and sodium) detected in the site media were not identified as COCs because no toxicity criteria are available to quantitatively evaluate these chemicals. In addition, USEPA Region I does not advocate a quantitative evaluation of exposure for aluminum, copper, and iron because the only

available toxicity criteria for these chemicals are provisional reference doses based on allowable daily intakes rather than adverse effect levels. Exposure to these compounds is addressed in the general uncertainty section of the baseline human health risk assessment, Section 3.3.5.

A sufficient number of samples were collected for soil at the site, consequently, UCLs were used as exposure concentrations if the distribution of the data set was determined to be lognormal or normal. When the distribution of the data set was undefined, exposure concentrations for the CTE and RME scenarios reflect the average and maximum concentrations, respectively. Maximum and average concentrations were used for groundwater. A summary of the COCs and exposure concentrations for each media is presented in Table 6-13.

6.6.2 Exposure Assessment

Three potential receptor groups, full-time employees, older child trespassers, and construction workers, were considered for the Area A Landfill. Each is summarized in this section. The details on the specific exposure assumptions were presented in Section 3.3.3.6.

The full-time employee and the older child trespasser could come into contact with surface soil via incidental ingestion and dermal contact. For the full-time employee, exposures are assumed to occur 150 days/year for either 25 years (RME) or 6 years (CTE). Contact with soil for the older child trespasser is expected to occur on an infrequent basis (i.e., 52 days/year for 3 years under the CTE and 120 days/year for 10 years under the RME).

The construction worker is defined as having a one-time exposure to "all soil" (soil from depths of 0 to 10 feet) while involved in a 1-year construction project. Under the RME scenario, a construction worker could conceivably be exposed for a period of 120 days, while the CTE worker is assumed to be exposed for 80 days.

Because of the nature of the site, a future residential exposure scenario was not considered. Therefore, the only exposure to groundwater at the Area A Landfill is assumed to be direct contact with this medium during construction activities. Exposure is presumed to occur throughout the entire duration of the construction project.

Potential receptors could also be exposed to soil chemicals via inhalation of fugitive dust and volatile emissions. This exposure pathway is evaluated qualitatively by a comparison of maximum soil concentrations to USEPA SSLs for the inhalation pathway, as summarized in the site-specific COC summary

screening tables in Appendix F.5. Maximum concentrations for all soil chemicals, except chromium in the subsurface soil, were below the inhalation SSLs. Chromium was assumed to be present as hexavalent chromium. This is an extremely conservative assumption since it is unlikely that all chromium is present in the hexavalent state. Although the maximum detection of chromium in the subsurface soil samples exceeded the SSL for hexavalent chromium, overall, the qualitative analysis indicates that the inhalation exposure pathway is not a significant route of exposure. It should also be noted that chromium was retained as a COC for soil at the site, and exposure to this chemical was addressed via incidental ingestion and dermal contact.

6.6.3 Risk Characterization

The quantitative risk assessment for the Area A Landfill is summarized in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor, are presented in Table 6-14 for the RME and CTE scenarios. Sample calculations are provided in Appendix F.3. Chemical-specific risks for the site are contained in Appendix F.5.

6.6.3.1 Noncarcinogenic Risks

Cumulative Hazard Indices (HIs) for the full-time employee and the older child trespasser were less than unity for the CTE scenario. Cumulative HIs for these receptors under the RME (1.2 for the full-time employee and 1.4 for the older child trespasser) slightly exceeded unity. Anticipated toxic effects under the defined exposure scenario are attributed to PCBs, which were detected at a total maximum concentration of 13 mg/kg in the surface soil samples. Aroclors-1248, -1254, and 1260 contribute to approximately 90% of the RME noncarcinogenic risks. Dermal contact with soil is the primary exposure route of concern for these receptors.

For the construction worker, cumulative HIs for both RME and CTE scenarios (8200 and 430, respectively) exceeded unity. Dermal contact with groundwater is the only significant exposure route under the CTE, whereas, HIs for all exposure routes involving soil and groundwater exceeded unity under the RME. Elevated risks for the construction worker are a result of exposure to PCBs, which were detected in the soil and groundwater at the site. As seen in Appendix F.5, all individual Hazard Quotients (HQs) for PCBs exceeded unity, except for incidental ingestion and dermal contact with soil under the CTE.

6.6.3.2 Carcinogenic Risks

Cumulative incremental cancer risks for the full-time employee and older child trespasser ranged from $4.7\text{E-}8$ (CTE for the older child trespasser) to $1.9\text{E-}5$ (RME for the full-time employee). All carcinogenic risks for these receptors were either less than $1\text{E-}6$ or within the USEPA's target risk range ($1\text{E-}4$ to $1\text{E-}6$).

The cumulative incremental cancer risk for the construction worker under the CTE, $4.0\text{E-}5$, was within the USEPA's target risk range. The cumulative incremental cancer risk under the RME ($9.9\text{E-}4$) exceeded $1\text{E-}4$, the upper limit of the USEPA's target risk range. Dermal contact with groundwater is the only exposure route of concern for the construction worker. PCBs are the sole chemicals of interest for this exposure route. Estimated risks associated with incidental ingestion of and dermal contact with soil are relatively insignificant.

6.6.3.3 Exposure to Lead

For the Area A Landfill, lead was retained as a COC for groundwater and soil because maximum detected concentrations of this chemical exceeded the Federal Action Level ($15\text{ }\mu\text{g/L}$) for drinking water and the 400 mg/kg OSWER soil screening level for residential land use. Exposure to lead was addressed using the USEPA IEUBK Model, as discussed in Section 3.3.3; support documentation for the site-specific analysis is provided in Appendix F.5. UCLs [$14.2\text{ }\mu\text{g/L}$ for groundwater and 915 mg/kg for "all soil" (soil from depths of 0 to 10 feet)], as well as several default parameters (for air, dust, and maternal contribution), were used to estimate blood lead levels for children in a residential setting. The estimated geometric mean blood lead level for exposure to lead in the site media is $7.4\text{ }\mu\text{g/dL}$. No adverse effects are anticipated for a child in a residential setting under since this value is less than the established level of "concern", $10\text{ }\mu\text{g/dL}$.

6.6.3.4 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 3.3.5. Site-specific uncertainties for the risk evaluation for the Area A Landfill are presented below.

Some inorganic chemicals detected in site soil samples may be attributable to naturally occurring background levels. Background levels for metals in soil at NSB-NLON, developed by Atlantic Environmental Services, Inc., were presented on Table 1-2. Reported concentrations of aluminum and iron in the site surface soils were below the established background levels. Detections of arsenic, selenium, and vanadium

may also be a result of background conditions because maximum detections of these analytes in surface soil only slightly exceeded the background concentrations.

For this risk assessment, construction workers were assumed to come in contact with shallow and deep groundwater during excavation activities. The resulting estimated risks for this exposure route are overestimated to a certain degree since this receptor is more likely to be exposed to shallow groundwater. Several organic compounds (1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene) were identified as COCs for groundwater, but were detected in the deep wells only. The inclusion of deep and shallow groundwater data is not expected to significantly overestimate risks for the construction worker since elevated risks for this receptor are primarily attributed to the presence of PCBs, which were detected in the groundwater samples from shallow monitoring wells.

Some degree of uncertainty is associated with the use of validated data only in the baseline human health risk assessment. Field screening data for PCBs, Aroclor-1248 and Aroclor-1254, are available for 10 additional surface and subsurface soil samples collected from two locations at the site (TB13 and TB23). Reported concentrations of Aroclor-1248 in the field screening samples ranged from 51 $\mu\text{g/kg}$ to 3,700 $\mu\text{g/kg}$. Aroclor-1254 was detected in the field screening samples at concentrations ranging from 110 $\mu\text{g/kg}$ to 19,400 $\mu\text{g/kg}$. Total PCB results for the field screening samples are similar to total PCB results in the soil samples subject to data validation. Although the field screening data were not used in the risk assessment, potential human health risks associated with the entire site are expected to be adequately addressed by the use of the validated data for 40 soil samples collected at the site.

6.7 ECOLOGICAL RISK ASSESSMENT

This section contains a site-specific ecological risk assessment for the Area A Landfill. The process followed to determine exposure point concentrations and the methodology used to characterize risks to ecological receptors is summarized in Section 3.4. Detailed calculations are provided in Appendix I.2.

6.7.1 Conceptual Site Model

Surface soil samples (0 to 2 feet) were collected from the Area A Landfill and analyzed. However, as discussed in Section 6.3.6, the Area A Landfill only provides limited habitat for ecological receptors; the landfill supports limited vegetation (e.g., grasses and an area of relatively thick brush on the eastern end of the landfill) and is generally characterized by exposed soil and gravel. Under current conditions, ecological receptors are most likely to be exposed to chemicals associated with the Area A Landfill surface soils by

direct contact as they move across the Area A Landfill from either the wooded ravine or from the Area A Wetland that borders the landfill.

6.7.2 Exposure Assessment

As discussed in Section 6.3.6, the Area A Landfill only provides limited cover for terrestrial receptors but the ravine to the south of the Area A landfill supports a well developed cover (mature trees and understory vegetation). In addition, the nearby Area A Wetland is characterized by dense *Phragmites sp.* growth and small areas of open water. While *Phragmites sp.* is of limited habitat value (e.g., does not provide food for wildlife), it does provide cover for ecological receptors. As such, the area surrounding the Area A Landfill is likely to be utilized by small mammals and birds. Although the Area A Landfill only provides limited habitat for wildlife receptors, for the purposes of this ecological risk assessment, it was conservatively assumed to support a diverse biological community. Complete exposure pathways for this site therefore included potential uptake via roots by terrestrial vegetation and exposure of soil invertebrates via direct contact with contaminants present in soil moisture or through ingestion. Complete exposure pathways for small mammals include direct contact with surface soil, incidental ingestion of soil while foraging, and consumption of contaminated prey. Predators could be exposed to soil at this site via consumption of contaminated prey or incidental ingestion of soil while foraging on the site.

6.7.3 Receptor Organisms

Although the Area A Landfill only provides limited wildlife habitat and is unlikely to represent a foraging area for ecological receptors, it was assumed that the Area A Landfill was well vegetated and that the site supported a population of soil invertebrates. Short-tail shrews were assumed to inhabit and forage in the area, preying on soil invertebrates (earthworms). The short-tailed shrew in turn served as prey for red-tailed hawks. The same conservative assumptions summarized in Section 3.4.4.2 were retained for this assessment.

6.7.4 Chemicals of Concern

As discussed in Section 6.7.1, surface soils (0 to 2 feet) are the only medium to which ecological receptors are likely to come in contact. Chemicals of concern associated with this medium were selected by comparing exposure point concentrations (both maximum and average values; Appendix I.2) detected in surface soil samples collected from the site to the following benchmarks (see also Section 3.4.2):

- Inorganic concentrations were compared to concentrations of inorganic constituents present in samples collected from background locations.
- With the exception of aluminum (see Section 6.7.5.1), inorganics present at concentrations greater than concentrations of background constituents and all organic compounds were compared to conservative benchmark values protective of terrestrial vegetation, soil invertebrates, the short-tailed shrew, and the red-tailed hawk.

Chemicals of concern identified as a result of comparing both the maximum and average concentrations of chemicals detected in surface soils collected from this area are summarized in Table 6-15.

6.7.5 Risk Characterization

The ecological risk characterization for the Area A Landfill is summarized in this section. Risks to terrestrial vegetation, soil invertebrates, and terrestrial vertebrates are elevated. Detailed media- and receptor-specific calculations used to determine ecological risks for this site are contained in Appendix I.2.

6.7.5.1 Terrestrial Vegetation

As discussed in Section 3.4.2.3, potential risks to terrestrial vegetation were determined by comparing chemical concentrations to conservative, phytotoxic benchmarks. As noted above, aluminum was detected in concentrations less than background concentrations, but was present at concentrations that exceeded its benchmark value for terrestrial vegetation. This metal was therefore retained as a chemical of concern. As discussed in Section 3.4.2.3, the benchmark values listed in Will and Suter (1994) are conservative and do not consider site-specific soil characteristics which may affect bioavailability of contaminants (and their potential toxicity) to plants. Maximum and average chemical concentrations detected in site surface soil samples (0 to 2 feet) were compared to these phytotoxic benchmark values and Hazard Quotients (HQs) were determined. Contaminants associated with the Area A Landfill were considered to represent a risk to terrestrial vegetation if the HQs exceeded 1.0. The HQs determined using maximum and average concentrations for this site are summarized in Tables 6-16 and 6-17, respectively.

When maximum concentrations in soil were compared to phytotoxic benchmark values, 9 inorganics with HQs greater than 1.0 were identified (Table 6-16). Of these inorganics, aluminum ($HQ = 1.6E+2$) and zinc ($HQ = 4.3E+1$) accounted for the majority of the potential risk to these receptors. Chromium and vanadium also contributed significantly ($HQs = 1.7E+1$ and $1.2E+1$, respectively). Fewer analytes were present at average concentrations that exceeded background concentrations and the resulting HQs were

somewhat lower than those calculated when the maximum values were compared to the benchmark values (Table 6-17). However, although the values were lower, the average concentrations of several of the chemicals detected in surface soils resulted in HQs much greater than 1.0. As noted above, background concentrations also exceed the phytotoxic benchmark value for aluminum, suggesting that this benchmark value may be too conservative for this area. However, the results of this screening assessment do suggest that vegetation associated with the Area A Landfill may be adversely impacted by these soil chemicals.

6.7.5.2 Terrestrial Fauna

Soil Invertebrates

Conservative benchmark values protective of earthworms were used to identify potential risks to soil invertebrates inhabiting the Area A Landfill. The maximum and average concentrations of inorganics detected in surface soil (0 to 2 feet) samples were compared to background concentrations. Inorganics present at concentrations greater than background values and all organic compounds were then compared to benchmark values developed for earthworms (see Section 3.4.2.3) and HQs were determined. Chemicals associated with the Area A Landfill were considered to represent a risk to terrestrial invertebrates if the HQs exceeded 1.0. The HQs determined using maximum and average concentrations for this site are summarized in Tables 6-18 and 6-19.

Of the chemicals detected in surface soil samples collected from the Area A Landfill, only the maximum concentrations of copper (HQ = $2.7E+1$) and lead (HQ = $6.2E+0$) were present at concentrations that represent a potential risk to soil invertebrates (Table 6-18). The average concentrations of both of these metals also exceeded the soil invertebrate benchmark values, producing HQs of $4.2E+0$ and $1.4E+0$, respectively (Table 6-19). As discussed in Section 3.4.2.3, data concerning the toxicity of soil chemicals to soil invertebrates is limited and difficult to interpret due to the influence that soil characteristics have on chemical bioavailability. With the exception of copper, the main concern associated with soil invertebrates and soil is that chemicals may accumulate in these organisms at concentrations that may adversely impact predator species. Copper on the other hand, has been demonstrated to eliminate earthworms from surface soils. The results of this assessment indicate that both copper and lead are present at concentrations that could adversely impact Area A Landfill soil invertebrates.

Terrestrial Vertebrates

Although the Area A Landfill currently represents only limited habitat for terrestrial vertebrate receptors, potential risks to these receptors were evaluated by examining potential risks to short-tailed shrews and red-

tailed hawks. Exposure pathways considered in this assessment for this site included the ingestion of prey and the incidental ingestion of soil. Because surface soil (0 to 2 feet) was the only contaminated medium associated with this site, potential risks associated other exposure pathways (e.g., ingestion of water) were not considered. All calculations are contained in Appendix I.2.

As discussed in Section 3.5.3, risks to terrestrial receptors are expressed in terms of HIs, which are the sum of chemical-specific HQs. HIs calculated for each receptor exposed to the maximum soil concentrations associated with the Area A Landfill are summarized in Table 6-20 while HI values based on comparisons of average surface soil concentrations to benchmark values are summarized in Table 6-21.

The HI calculated for the short-tailed shrew was $7.5E+6$, indicating that this species was potentially at risk as a result of exposure to the maximum chemical concentrations found in site surface soils. Octylchlorodibenzo-p-dioxin (OCDD) was the most significant contributor (100%) to this receptor's HI value (Table 6-20). No toxicological endpoint could be identified for OCDD and benchmark values for this species were based on toxicological endpoints for the closely related chemical, tetrachlorodibenzo-p-dioxin (see Table 3-22). While the impacts of TCDD on wildlife receptors is still undergoing investigation, studies to date suggest that TCDD and related contaminants can adversely impact ecological receptors at very low concentrations. Ingestion of food (earthworms) contributed 82.3% of the total exposure, with the incidental ingestion of soil accounting for 17.7% (Table 6-20).

HIs calculated using average soil concentrations still yielded very high HQ values. The HI for the short-tailed shrew equalled $6.1E+6$ while the HI calculated for the red-tailed hawk was $4.1E+3$ (Table 6-21). These values are only slightly less than the HIs generated when maximum soil concentrations were compared to benchmark values protective of these two receptors. OCDD remained the primary contributor to the HI values calculated for the short-tailed shrew and the red-tailed hawk (100% and 98.4%, respectively; Table 6-21). While the average concentrations of several other surface soil chemicals resulted in HIs much greater than 1.0, their contribution to the HIs for both species was minor. Ingestion of prey contributed significantly to the exposure of both species to surface soil contaminants detected at the Area A Landfill. These results indicate that, given the conservative assumptions used to calculate HIs for these two receptors, terrestrial vertebrates utilizing the Area A Landfill are potentially at risk as a result of exposure to surface soil contaminants.

Using acute toxicity benchmarks, OCDD exceeded the acute benchmark for both maximum and average contaminant concentrations for the short-tailed shrew (Appendix I.2). No HIs > 1 were calculated for the red-tailed hawk using acute benchmarks for either the maximum or average concentration scenario.

6.7.5.3 Uncertainties

As discussed in Section 3.4, the following conservative assumptions were maintained in performing this ecological risk assessment:

- the site use factor was assumed to equal 100% (i.e., the organisms were assumed to live and forage exclusively within the boundaries of this site),
- minimum body weights were used to calculate receptor dose
- maximum ingestion rates were used to calculate receptor dose
- contaminants were assumed to be 100% biologically available
- the most sensitive life stage was assumed to be exposed to site contaminants
- it was assumed that only contaminated prey were consumed.

By adopting these conservative assumptions, the final risk estimates are deliberately conservative and are likely to overestimate the actual risk associated with contaminants detected at the Area A Landfill. This approach was taken so it may be concluded with confidence that certain chemicals detected at this site are unlikely to represent an ecological risk. While this process serves to significantly reduce the uncertainty associated with eliminating certain chemicals from further consideration, uncertainty is associated with concluding that exposure to the remaining chemicals are adversely impacting ecological receptors. An analysis of the uncertainty associated with the risk assessment process is important in that it identifies, and, to the extent possible, quantifies the uncertainty associated the entire process (problem formulation, data analysis and risk characterization). The uncertainty introduced into the risk assessment process stems from three sources: 1) imperfect knowledge of things that should be known, 2) systematic errors (e.g, computational, data, or analytical transformation errors), and 3) nonsystematic errors (i.e., random or stochastic errors) and variability in the system being assessed (Solomon et. al, 1996). A detailed discussion of uncertainties associated with the assessment process is contained in Section 3.4. This section focuses on uncertainties and assumptions that should be considered when interpreting the results of the ecological risk assessment performed at the Area A Landfill.

It was assumed that the Area A Landfill represented desirable habitat for wildlife receptors and that these receptors could come into contact with chemicals in the surface soil. As discussed in Section 6.3.6, the Area A Landfill offers limited cover and forage for ecological receptors. The southern portion of the site is paved. These factors reduce the possibility that ecological receptors will utilize the site and come into contact with soil contaminants. The assumption that the Area A Landfill supports ecological receptors with ready access to site contaminants results in an overestimation of risk.

As noted above, it was also conservatively assumed that the site use factors for both the shrew and the red-tailed hawk equaled 100%. This site encompasses approximately 4.8 ha. Therefore, based on the shrew's home range (0.1 - 0.22 ha; Table 3-27), this assumption is probably appropriate. However, as indicated above, it was also assumed that this receptor exclusively consumed contaminated prey. It is much more likely that the shrew would feed on contaminated and uncontaminated prey, which would reduce its exposure to site contaminants. This assumption therefore results in an overestimation of risk.

Unlike the shrew, the home range of the red-tailed hawk is much larger (60 - 160 ha) than the areal extent of this site; the Area A Landfill represents approximately 8.0% of the hawk's home range. When this value is factored into the HI calculations for this species, the resulting HI values decrease approximately an order of magnitude. These recalculated values provide an indication of the conservative nature of the original set of HI calculations. However, despite this decrease, these recalculated HI values still suggest that red-tailed hawks that utilize the Area A Landfill are potentially at risk.

Uncertainty is also associated with characterizing the toxicity of contaminants detected at this site. Of these contaminants, it was determined that aluminum contributed to the potential risk calculated for terrestrial vegetation. According to Will and Suter (1994), aluminum exerts a toxic response in terrestrial vegetation by interfering with cellular division in roots, decreasing root respiration, binds with phosphorus so that it is not biologically available, interferes with the uptake of essential nutrients (calcium, magnesium, phosphorus) and water, and disrupts enzyme activity. Seedlings are more susceptible to the effects of aluminum toxicity than are older plants (Will and Suter, 1994).

As discussed in Section 6.7.5.1, the concentrations of aluminum detected at this location were less than background values but were greater than the benchmark value used to assess risks to terrestrial vegetation. This indicates that the benchmark value for this metal is probably overly conservative. The aluminum benchmark value used to determine if this metal represented a potential risk to terrestrial vegetation was taken from Will and Suter (1994). The benchmark is based on the results of a single study that documented a 30% reduction in white clover seedling establishment when 50 mg/kg aluminum was added to a sandy loam soil with a pH of 5.0. Because only a single study describing the phytotoxicity of aluminum could be identified, the confidence in this benchmark, and therefore the conclusions regarding the potential impacts of aluminum on vegetation within the Area A Landfill is limited.

The results of the risk assessment determined that copper represented a risk to soil invertebrates associated with this site. As noted in section 6.7.5.2, copper represents one of a handful of contaminants whose impact on soil invertebrates has been relatively well-documented. However, although the risk assessment indicated that this contaminant represented a potential risk to these receptors, additional site-specific data (e.g., soil

toxicity tests) are necessary to reduce the uncertainty associated with concluding that this contaminant is biologically available in concentrations that would adversely impact these receptors.

Of the contaminants detected at the Area A Landfill, it was determined that OCDD contributed most significantly to the HIs calculated for both the shrew and red-tailed hawk (Tables 6-20 and 6-21). While the suite of effects of OCDD and other dioxin-like compounds appears diverse, research indicates that these effects appear to be caused by a common mode of action. The most widely accepted proposed mechanism for their action appears to be associated with the subcellular Ah receptor. These chemicals bind to the Ah receptor and then exert specific changes in genetic expression. These effects are generally not acutely toxic, but tend to cause chronic toxic responses. Perhaps the most subtle and important of these effects on wildlife are the effects on endocrine hormones and vitamin homeostasis (USEPA, 1994).

As discussed in Section 6.7.5.2, no toxicological endpoints were identified for OCDD. Instead, benchmark values for this chemical were based on the closely related chemical, tetrachlorodibenzo-p-dioxin. According to USEPA (1994), TCDD is the most potent polychlorinated hydrocarbon identified to date. Therefore, use of benchmarks associated with this chemical are likely to be overly conservative for other chemicals such as OCDD.

The TCDD benchmark value for the shrew was based on a study performed on rats and summarized in Opresko et al. (1994). This particular study extended over three generations and included exposure during critical life stages (e.g., reproduction and early life stages). These test conditions increase the confidence associated with these test results. Test organisms were exposed to three different doses of TCDD administered orally in the diet. Test results identified both a LOAEL and a NOAEL, further increasing the confidence associated with these results.

The benchmark used to assess the risks to red-tailed hawks exposed to OCDD were based on studies conducted to determine the toxicity of TCDD to ring-necked pheasants. These test results are also summarized in Opresko et al. (1994). The study extended for more than 10 weeks and included a critical lifestage (reproduction). These dose levels were administered via interperitoneal injection which was believed to be comparable to oral routes of exposure. The results of the test therefore represent the effects of long term chronic exposure and are consistent with the assumption that exposure to site contaminants is also probably chronic. Chronic exposure to TCDD resulted in a reduction in egg production and hatchability. Test results identified both a LOAEL and a NOAEL, increasing the confidence associated with these results.

Although benchmarks for both the shrew and the red-tailed hawk were based on studies that quantified reproductive effects, recent studies suggest that impacts to adults, rather than reproduction, may represent more sensitive endpoints. A great deal of uncertainty is also associated with determining concentrations that can be related to ecological risk; this uncertainty stems in part from difficulties associated with quantifying these types of chemicals, determining routes of exposure, and bioaccumulation. Research regarding the significance of environmental concentrations of polychlorinated hydrocarbons is ongoing.

6.8 COMPARISON OF SITE DATA TO CONNECTICUT STANDARDS

Analytical data for the Area A Landfill were compared to Connecticut drinking water standards and remediation standards (CTDEP, January 1996). Tables summarizing the comparison of site data to Connecticut standards are provided in Appendix F.5. These tables, which follow the quantitative risk assessment spreadsheets in the cited appendix, identify, on a media-specific basis, those chemicals detected at concentrations in excess of state criteria. Maximum and average chemical concentrations are presented in the summary tables. Although the maximum concentration of a chemical may exceed an associated state criteria, the distribution of the chemical in the medium is also important with respect to decision making. Therefore, the average chemical concentration was included to provide some information on the potential distribution of the chemical. A brief narrative of the findings of this qualitative analysis is provided in the remainder of this section.

Site-specific soil data were compared to Connecticut remediation standards for direct exposure and pollutant mobility. Based on conversations with the State, USEPA, and Navy (October 25, 1995c), an industrial land use scenario is considered to be the most likely exposure scenario for the site. The following chemicals were found at maximum concentrations exceeding the state remediation standard for direct exposure under industrial land use:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Aroclor-1254
- Aroclor-1260
- Arsenic
- Beryllium
- Chromium
- Lead

To address concerns regarding migration of chemicals from soil to groundwater, site soil data were compared to Connecticut remediation standards for pollutant mobility. The groundwater classification for the Area A Landfill is GB, which indicates although the State recognizes that groundwater may not meet GA criteria at this time, the goal is to restore groundwater to GA quality. The list of chemicals reported at maximum concentrations exceeding the GB pollutant mobility criteria consists of:

- Ethylbenzene
- Xylenes (total)
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(k)fluoranthene
- Benzo(b)fluoranthene
- Phenanthrene
- Dieldrin
- Heptachlor
- Cadmium
- Lead

As indicated above, TCLP analytical results for several metals exceeded the state pollutant mobility criteria. A qualitative evaluation of the TCLP analytical results for the site soil samples (in relation to state pollutant mobility criteria for inorganics and PCBs) is provided in Table 6-5.

Analytical groundwater data for the site were compared to Connecticut MCLs and remediation standards for groundwater and surface water protection. The following chemicals were detected in the unfiltered groundwater samples at maxima exceeding the state MCLs:

- Benzene
- Chlorobenzene
- Methylene chloride
- Trichloroethene
- 1,2,4-Trichlorobenzene
- 1,4-Dichlorobenzene
- Bis(2-ethylhexyl)phthalate
- Aroclor-1016
- Aroclor-1254
- Aroclor-1260

- Antimony
- Beryllium
- Cadmium
- Chromium
- Thallium

Exceedances of Connecticut MCLs were observed for antimony and thallium in the filtered groundwater samples. In addition, sodium was detected in the unfiltered and filtered samples at maximum concentrations exceeding the 28 mg/L state Notification Level.

Maximum groundwater concentrations (unfiltered and/or filtered) for the following chemicals exceeded the Connecticut remediation standards for groundwater protection:

- 1,1,2,2-Tetrachloroethane
- Benzene
- Chlorobenzene
- Chloroform
- Methylene chloride
- Trichloroethene
- Xylenes
- 1,4-Dichlorobenzene
- Bis(2-ethylhexyl)phthalate
- Aroclor-1016
- Aroclor-1254
- Aroclor-1260
- Antimony
- Beryllium
- Cadmium
- Chromium
- Lead
- Vanadium

It should be noted that the groundwater protection criteria are applicable for GA or GAA designated groundwater and are also used to protect existing groundwater regardless of the classification.

Since groundwater at the Area A Landfill eventually discharges to a surface water body (i.e., Thames River), site-specific groundwater data were also compared to Connecticut remediation standards for surface water protection. Those chemicals found at unfiltered and/or filtered maxima exceeding the surface water protection criteria are, as follows:

- 1,1,2,2-Tetrachloroethane
- Bis(2-ethylhexyl)phthalate
- Phenanthrene
- Aroclor-1016
- Aroclor-1254
- Aroclor-1260
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Zinc

Maximum and average chemical concentrations are presented in the summary tables. Although the maximum concentration of a chemical may exceed an associated state criteria, the distribution of the chemical in the medium is also important with respect to decision making. Therefore, the average chemical concentration was included to provide some information on the potential distribution of the chemical.

6.9 SUMMARY AND CONCLUSIONS

This section presents a summary of major findings of the investigations for the Area A Landfill. A summary of the nature and extent of contamination is provided in Section 6.9.1. Sections 6.9.2 and 6.9.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section 6.9.4 summarizes the comparison of site data to state standards and Section 6.9.5 provides recommendations regarding additional action or investigatory efforts for the site.

6.9.1 Nature and Extent of Contamination

Relatively high concentrations of various organic and inorganic chemicals were detected in a few soil samples collected from the Area A Landfill. Examples included such chemicals as ethylbenzene

(28,000 $\mu\text{g/kg}$), xylenes (140,000 $\mu\text{g/kg}$), chlorobenzene (4,500 $\mu\text{g/kg}$), Aroclor-1254 (100,000 $\mu\text{g/kg}$), Aroclor-1260 (12,000 $\mu\text{g/kg}$), and several PAHs. Contamination in the landfill materials appears to be relatively sporadic. Many of the soil samples collected exhibited only minimal or no contamination.

Groundwater samples collected at this site also demonstrated the sporadic presence of organic chemicals. Benzene, ethylbenzene, xylenes, dichlorobenzene isomers, naphthalene, 2-methylnaphthalene, 1,1,2,2-tetrachloroethane, and trichloroethene are some of the compounds detected in the groundwater samples. Concentrations of these analytes ranged as high as 1,200 $\mu\text{g/L}$ (chlorobenzene). It should be noted that the majority of contamination is limited to the shallow groundwater. Only one deep monitoring well, 2LMW13D contained organic compounds. Based on the available analytical results, it is concluded that the Area A Landfill contains several potentially mobile chemicals at relatively high concentrations and is acting as a source of groundwater contamination.

6.9.2 Baseline Human Health Risk Assessment

The baseline human health risk assessment for the Area A Landfill site considered the potential exposure of multiple receptor groups (including full-time workers, older child trespassers, and construction workers). The assessment demonstrated that construction workers may incur incremental lifetime cancer risks exceeding the upper bound of the USEPA's target risk range ($1\text{E-}4$). Elevated noncarcinogenic hazards were estimated for all receptor groups. Based on the results of the risk assessment, it is concluded that the Area A Landfill may pose a threat to the public health and to the groundwater at the facility under the defined exposure scenarios. All potential toxic effects for the Area A Landfill are attributed to PCBs.

6.9.3 Ecological Risk Assessment

As described in Section 6.3.6, the Area A Landfill currently represents generally limited wildlife habitat due to its gravel cover, the pavement covering the landfill's concrete pad and proximity to areas of high human activity (e.g., the Area A Weapons Center). The Area A Landfill does border areas that do represent potential wildlife habitat or may provide cover for ecological receptors. Using the conservative assumptions discussed in Section 3.4.4.2, both the maximum and average concentrations of chemicals detected in surface soils (0 to 2 feet) collected from this site exceeded benchmark values protective of various terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. Potential risks to terrestrial vegetation and soil invertebrates were associated with the presence of heavy metals. Potential risks to vertebrate species were almost entirely associated with OCDD, a compound closely related to TCDD. These results indicate that if the Area A Landfill provided habitat and forage for terrestrial receptors, organisms

utilizing this area would potentially be at risk. However, because of the current conditions associated with this site, actual risks to ecological receptors are likely to be much less than those calculated for this area. Areas bordering the Area A Landfill (e.g., the wooded hillside) do represent desirable habitat for wildlife. Organisms inhabiting this area may come in contact with soil contaminants associated with the site while moving through the area to forage in the nearby Area A Wetland or Area A Downstream Watercourses. While potentially exposed to soil contaminants, this exposure is much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby reducing the actual ecological risks associated with this site. In addition, this area is to be capped (see Section 6.1); capping the Area A Landfill will eliminate the possibility that ecological receptors will come in contact with these chemicals. When the current and future site conditions are factored into this evaluation, it is concluded that the Area A Landfill represents little potential risk to ecological receptors.

6.9.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 6.8. Although not retained as COCs in the baseline human health risk assessment, ethylbenzene, xylenes, phenanthrene, dieldrin and heptachlor were reported at maxima in excess of Connecticut remediation standards for pollutant mobility.

While these compounds may migrate to groundwater and potentially impact water quality, no dose-response parameters are available to quantitatively evaluate exposure to phenanthrene, and detected maximum concentrations for the remaining chemicals were less than human health risk-based COC screening levels for soil ingestion.

For groundwater, maxima of a few chemicals (xylenes, phenanthrene, copper, sodium, and zinc) exceeded the applicable state standards, but were not identified as COCs in the baseline human health risk assessment. No dose-response parameters are available to quantitatively address exposure to phenanthrene and sodium. It should be noted that the applicable state standard for sodium is a Notification Level for a drinking water source. The remaining chemicals were reported at concentrations less than the risk-based COC screening levels for tap water ingestion.

6.9.5 Recommendations

It is recommended that a "limited action" approach, involving a groundwater monitoring program and access/use restrictions be implemented at the Area A Landfill, in addition to the planned Area A Landfill cap. This recommendation is based on the following information:

- Relatively high concentrations of organic and inorganic chemicals were detected in a few soil samples at the site. The soil contamination appears to be located sporadically throughout the site.
- Groundwater contamination exists at the site and is primarily limited to the shallow groundwater.
- Noncarcinogenic hazards exceed the USEPA acceptable limit of one for all receptor groups with the exception of the CTE older child trespasser and the CTE full-time employee. Lifetime incremental carcinogenic risks exceed the upper bound ($1E-4$) of USEPA's acceptable target risk range for the construction worker under the RME scenario. Therefore, the landfill may pose a threat to human receptors at the facility. This threat is due entirely to the presence of PCBs at the site.
- Chemicals in the soil could adversely impact ecological receptors. It should be noted, however, that the site does not provide a desirable ecological habitat and highly conservative assumptions were used to evaluate ecological risks. Furthermore, the installation of the cap will eliminate risks to ecological receptors.

As required by the September 1995 ROD, the Navy is planning to cap the Area A Landfill and to intercept the upgradient surface runoff and shallow groundwater before entering the site as part of an Interim Remedial Action (IRA). Groundwater at this site will also be monitored as required by the ROD. The planned IRA will eliminate the dermal contact exposure route and reduce infiltration and subsequent contaminant loading to the groundwater. The IRA was originally intended to address minimization of risk associated with soils at this site pending the outcome of this Phase II RI effort, which would address all remaining media. However, the components of the IRA (cap, upgradient surface runoff and shallow groundwater interception, and long-term post-closure shallow and deep groundwater monitoring) are presently addressing all media of concern identified in this report (soil and groundwater). The need for remedial action for groundwater at this site will be evaluated as the results of the groundwater monitoring program become available.

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TABLE 6-1

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
SOIL							
2LSS1	0-0.5	● ⁽⁵⁾	●	●	●	●	
2LSS2	0-0.5	●	●	●	●	●	
2LTB2	2-8	●	●	●	●	●	
2LMW7	7-10	●	●	●	●	●	
2LMW8S	6-10	●	●	●	●	●	
2LMW9	0-4	●	●	●	●	●	
2LMW19 ⁽⁶⁾	0-4	●	●	●	●	●	
2LMW9	2-8	●	●	●	●	●	
2LMW13	2-4	●	●	●	●	●	
2LMW33 ⁽⁷⁾	2-4	●	●	●	●	●	
2LMW13	6-8	●	●	●	●	●	
2LMW14S	5-7	●	●	●	●	●	
2LMW17	0-2	●	●	●	●	●	
2LMW17	4-8	●	●	●	●	●	
2LMW18S	0-2	●	●	●	●	●	
2LMW18S	2-6	●	●	●	●	●	

TABLE 6-1
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
Page 2 of 3

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
GROUNDWATER							
010391-2LMW7S	--	●	●	●	●		●
010891-2LMW7D	--	●	●	●	●		●
010891-2LMW21D ⁽⁸⁾	--	●	●	●	●		
121490-2LMW8S	--	●	●	●	●		●
121790-2LMW8D	--	●	●	●	●		●
010291-2LMW9S	--	●	●	●	●		●
011091-2LMW9D	--	●	●	●	●		●
011091-2LMW13D	--	●	●	●	●		●
121790-2LMW14D	--	●	●	●	●		●
010291-2LMW17S	--	●	●	●	●		●
010891-2LMW17D	--	●	●	●	●		●
121390-2LMW18S	--	●	●	●	●		●
121390-2LMW19S ⁽⁹⁾	--	●	●	●	●		●
121390-2LMW18D	--	●	●	●	●		●

TABLE 6-1
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
Page 3 of 3

- 1 Polychlorinated Biphenyls.
- 2 Target Analyte List (TAL) metals plus cyanide.
- 3 Toxicity Characteristics Leaching Procedure (TCLP) for metals and pesticides.
- 4 Radiological analyses include gross alpha and gross beta analyses.
- 5 ● - Indicates samples analyzed at fixed-base laboratory.
- 6 2LMW19 is a field duplicate of 2LMW9 (0-4).
- 7 2LMW33 is a field duplicate of 2LMW13 (2-4).
- 8 2LMW21D is a field duplicate of 2LMW7D.
- 9 2LMW19S is a field duplicate of 2LMW18S.

TABLE 6-2

**SUMMARY OF SAMPLING AND ANALYSIS PROGRAM - PHASE II RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)			TAL Metals ⁽¹⁾		Radiological ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾
		Volatiles	Semivolatiles	PCBs ⁽²⁾	Total	Dissolved			
ROUND 1 - SOIL									
2LTB13-0001	0-1							● ⁽⁶⁾	
2LTB13-0001A	0-1			○ ⁽⁷⁾					
2LTB13-0102	1-2			○					
2LTB13-0204	2-4			○					
2LTB13-0406	4-6			○					
2LTB13-0608	6-8			○					
2LTB23-0002	0-2			○					
2LTB23-0406	4-6			○				●	
2LTB23-0608	6-8			○					
2LTB23-0810	8-10			○					
2LTB23-1012	10-12			○					
ROUND 1 - GROUNDWATER									
2LGW7S	--	●	●		●	●	●		
2LGW7D	--	●	●		●	●			

TABLE 6-2 (Continued)
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM - PHASE II RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)			TAL Metals ⁽¹⁾		Radiological ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾
		Volatiles	Semivolatiles	PCBs ⁽²⁾	Total	Dissolved			
2LGW8S	--	●	●		●	●			
2LGW8D	--	●	●		●	●			
2LGW9S	--	●	●		●	●			
2LGW9D	--	●	●		●	●	●		
2LGW13S	--	●	●		●	●			
2LGW13D	--	●	●		●	●	●		
2LGW14D	--	●	●		●	●			
2LGW17S	--	●	●		●	●			
2LGW17D	--	●	●		●	●			
2LGW18S	--	●	●	●	●	●	●		
2LGW18D	--	●	●		●	●			
2LGW19S	--	●	●		●	●			
2LGW19D	--	●	●		●	●			
2LGW20S	--	●	●		●	●			
2LGW20D	--	●	●		●	●			
2LPW1S	--				●	●			

TABLE 6-2 (Continued)
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM - PHASE II RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)			TAL Metals ⁽¹⁾		Radiological ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾
		Volatiles	Semivolatiles	PCBs ⁽²⁾	Total	Dissolved			
2LGW1S-X	--	●	●						
2LPW1S-1	--	●	●	●	●	●			●
2LPW1S-2	--	●							
2LPW1S-3	--	●							
2LPW1S-4	--	●							
2LPW1S-5	--	●							
2LPW1S-6	--	●							
2LPW1S-7	--	●	●	●	●	●			●
2LPW1S-8	--	●	●	●	●	●			●

ROUND 2 - GROUNDWATER

2LGW7S-2	--	●	●		●	●	●		
2LGW7D-2	--	●	●		●	●			
2LGW8S-2	--	●	●		●	●			
2LGW8D-2	--	●	●		●	●			
2LGW9D-2	--	●	●		●	●	●		
2LGW13D-2	--	●	●		●	●	●		

TABLE 6-2 (Continued)
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM - PHASE II RI
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)			TAL Metals ⁽¹⁾		Radiological ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾
		Volatiles	Semivolatiles	PCBs ⁽²⁾	Total	Dissolved			
2LGW17S-2	--	●	●		●	●			
2LGW17D-2	--	●	●		●	●			
2LGW18S-2	--	●	●	●	●	●	●		
2LGW18D-2	--	●	●		●	●			
2LGW19S-2	--	●	●		●	●			
2LGW19D-2	--	●	●		●	●			
2LGW20S-2	--	●	●		●	●			
2LGW20D-2	--	●	●		●	●			
2LGW20S-D-2 ⁽⁸⁾	--	●	●		●	●			

- 1 TAL Metals plus boron. Water samples were also analyzed for hardness. Sample 2LPW1S was analyzed for copper, zinc, nickel, and lead only.
- 2 Polychlorinated biphenyls.
- 3 Radiological analyses include gross alpha and beta and complete gamma spectrum analyses.
- 4 Dioxin analyses includes dioxins and dibenzofurans as specified in USEPA CLP SOW DFLM01.0.
- 5 Engineering parameters include oil and grease, ammonia, biochemical oxygen demand, chemical oxygen demand, total organic carbon, total phosphorus, and total suspended solids.
- 6 ● - Indicates samples analyzed at fixed-base laboratory.
- 7 ○ - Indicates samples analyzed in the field with portable gas chromatograph.
- 8 2LGW20S-D-2 is a field duplicate of 2LGW20S-2.

TABLE 6-3

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - FOCUSED FEASIBILITY STUDY
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis						
		Target Compound List (TCL)			TAL Metals ⁽²⁾ (Total)	Dioxin	Engineering ⁽³⁾	TCLP ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾				
SOIL								
2LSS20	0-1	● ⁽⁵⁾	●	●	●			
2LSS30 ⁽⁶⁾	0-1	●	●	●	●			
2LSS21	0-1	●	●	●	●			
2LSS22	0-1	●	●	●	●			
2LSS23	0-1	●	●	●	●			
2LSS24	0-1	●	●	●	●			
2LTB13	0-2	●	●	●	●	●		
2LTB16	0-2	●	●	●	●			
2LTB17	0-2	●	●	●	●		●	
2LTB18	0-2	●	●	●	●			●
2LTB19	2-4	●	●	●	●			
2LTB19	4-6						●	
2LTB20	6-8	●	●	●	●			
2LTB22	6-8	●	●		●			
2LTB22	8-10			●				
2LTB23	4-8	●	●	●	●	●		
2LTB33 ⁽⁷⁾	4-8	●	●	●	●	●		
2LTB26	4-6	●	●	●	●			●

TABLE 6-3 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - FOCUSED FEASIBILITY STUDY
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis						
		Target Compound List (TCL)			TAL Metals ⁽²⁾ (Total)	Dioxin	Engineering ⁽³⁾	TCLP ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾				
2LTB28	4-6	●	●	●	●			
2LTB29	10-12	●	●	●	●			
2LTB39 ⁽⁸⁾	10-12	●	●	●	●			
2LTB31	8-10	●	●	●	●			
2LTB9	0-2	●	●	●	●			
LF-SB03	18.5-20.5	●	●	●	●			
LF-SB04	8-10	●	●	●	●			
LF-SB05	12.5-14.5	●	●	●	●			
PAVEMENT								
2LC1				●				
2LC2				●				
2LC3				●				
2LC4				●				

1 Polychlorinated Biphenyls.

2 Target Analyte List (TAL) metals plus boron and cyanide.

3 Engineering parameters include grain-size distribution, moisture content, specific gravity, organic content, cation exchange capacity, pH, and total organic carbon content.

4 Toxicity Characteristic Leaching Procedure for volatile and semivolatile organics, pesticides/PCBs, herbicides and metals.

5 ● - Indicates samples analyzed at a fixed-base laboratory.

6 2LSS30 is a field duplicate of 2LSS20.

7 2LTB33 is a field duplicate of 2LTB23.

8 2LTB39 is a field duplicate of 2LTB29.

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LMW13(2-4)	2LMW33(2-4)	2LMW13(6-8)	2LMW14S(5-7)	2LMW17(0-2)	2LMW17(4-8)	2LMW18S(0-2)
DEPTH (feet):	2 - 4	2 - 4	6 - 8	5 - 7	0 - 2	4 - 8	0 - 2
LOCATION:	2LMW13S	2LMW13S	2LMW13S	2LMW14S	2LMW17S	2LMW17S	2LMW18S
SAMPLE DATE:	08/22/90	08/22/90	08/22/90	08/02/90	08/15/90	08/15/90	08/07/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

1,1,2,2-TETRACHLOROETHANE	6 U	5 U	6 U	22	5 U	6 U	5 U
1,1,2-TRICHLOROETHANE	6 U	5 U	6 U	11	5 U	6 U	5 U
2-BUTANONE	11 U	11 U	12 U	12 U	11 U	11 U	11 U
4-METHYL-2-PENTANONE	11 U	11 U	12 U	12 U	11 U	11 U	11 U
ACETONE	96	62	70	12 U	24 U	57 U	11 U
CARBON DISULFIDE	6 U	5 U	6 U	6 U	5 U	6 U	5 U
CHLOROBENZENE	6 U	5 U	6 U	6 U	5 U	6 U	5 U
ETHYLBENZENE	6 U	5 U	6 U	6 U	5 U	29	5 U
METHYLENE CHLORIDE	6 U	5 U	6 U	6 U	5 U	6 U	5 U
TETRACHLOROETHENE	6 U	5 U	6 U	6 U	5 U	6 U	5 U
TOLUENE	6 U	5 U	6 U	9 U	5 U	6 U	5 U
TRICHLOROETHENE	6 U	5 U	6 U	2 J	5 U	6 U	5 U
XYLENES, TOTAL	6 U	5 U	6 U	6 U	4 J	200	5 U

SEMIVOLATILES (UG/KG)

2,4-DIMETHYLPHENOL	370 U	360 U	390 U	410 U	350 U	370 U	350 U
2-METHYLNAPHTHALENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
4-METHYLPHENOL	370 U	360 U	390 U	410 U	350 U	370 U	350 U
ACENAPHTHENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
ACENAPHTHYLENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
ANTHRACENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
BENZO(A)ANTHRACENE	370 U	360 U	390 U	410 U	350 U	370 U	97 J
BENZO(A)PYRENE	370 U	360 U	390 U	410 U	46 J	370 U	350 U
BENZO(B)FLUORANTHENE	370 U	360 U	390 U	410 U	350 U	370 U	130 J
BENZO(G,H,I)PERYLENE	370 U	360 U	390 U	410 U	44 J	370 U	350 U
BENZO(K)FLUORANTHENE	370 U	360 U	390 U	410 U	57 J	370 U	84 J
BIS(2-ETHYLHEXYL)PHTHALATE	370 U	360 U	1900 U	78 J	350 U	910 U	390
CHRYSENE	370 U	360 U	390 U	410 U	37 J	370 U	120 J
DI-N-BUTYL PHTHALATE	370 U	360 U	390 U	410 U	61 J	370 U	350 U
DIBENZOFURAN	370 U	360 U	390 U	410 U	350 U	370 U	350 U
FLUORANTHENE	370 U	360 U	390 U	410 U	49 J	370 U	120 J

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LMW13(2-4)	2LMW33(2-4)	2LMW13(6-8)	2LMW14S(5-7)	2LMW17(0-2)	2LMW17(4-8)	2LMW18S(0-2)
DEPTH (feet):	2 - 4	2 - 4	6 - 8	5 - 7	0 - 2	4 - 8	0 - 2
LOCATION:	2LMW13S	2LMW13S	2LMW13S	2LMW14S	2LMW17S	2LMW17S	2LMW18S
SAMPLE DATE:	08/22/90	08/22/90	08/22/90	08/02/90	08/15/90	08/15/90	08/07/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
SEMIVOLATILES (UG/KG)							
FLUORENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
INDENO(1,2,3-CD)PYRENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
NAPHTHALENE	370 U	360 U	390 U	410 U	350 U	370 U	350 U
PHENANTHRENE	370 U	360 U	390 U	410 U	350 U	370 U	76 J
PYRENE	370 U	360 U	390 U	410 U	57 J	370 U	140 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	18 U	17 U	19 U	80 U	170 U	180 U	17 U
4,4'-DDE	18 U	17 U	19 U	80 U	170 U	180 U	17 U
4,4'-DDT	18 U	17 U	19 U	80 U	170 U	180 U	21 J
ALDRIN	9 U	8.7 U	9.5 U	40 U	86 U	90 U	8.4 U
ALPHA-CHLORDANE	90 U	87 U	95 U	400 U	860 U	900 U	84 U
AROCLOR-1242	90 U	87 U	95 U	400 U	860 U	900 U	84 U
AROCLOR-1248	90 U	87 U	95 U	400 U	860 U	900 U	84 U
AROCLOR-1254	180 U	170 U	190 U	800 U	1700 U	1800 U	170 U
AROCLOR-1260	180 U	170 U	190 U	800 U	1700 U	1800 U	170 U
DIELDRIN	18 U	17 U	19 U	80 U	170 U	180 U	17 U
ENDOSULFAN II	18 U	17 U	19 U	80 U	170 U	180 U	17 U
ENDOSULFAN-I	9 U	8.7 U	9.5 U	40 U	86 U	90 U	8.4 U
ENDRIN	18 U	17 U	19 U	80 U	170 U	180 U	17 U
ENDRIN KETONE	18 U	17 U	19 U	80 U	170 U	180 U	17 U
GAMMA-CHLORDANE	90 U	87 U	95 U	400 U	860 U	900 U	84 U
HEPTACHLOR	9 U	8.7 U	9.5 U	40 U	86 U	90 U	8.4 U
HEPTACHLOR EPOXIDE	9 U	8.7 U	9.5 U	40 U	86 U	90 U	8.4 U
METHOXYCHLOR	90 U	87 U	95 U	400 U	860 U	900 U	84 U
INORGANICS (MG/KG)							
ALUMINUM	12700	13600	15100	13300 J	8710	6740	6670
ANTIMONY	1.8 UJ	1.9 UJ	1.9 UJ	14.9 UR	12.8 UJ	13.4 UJ	12.5 UJ
ARSENIC	3.9	3.5	3.3	4.6 J	1.8	2.7	3.7 J
BARIUM	43.5	44.8	47.2	18.4 J	57.5	32.8	49.0
BERYLLIUM	0.54	0.63	0.62	0.54 J	0.42	0.46	0.65

TABLE 6-4

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LMW13(2-4)	2LMW33(2-4)	2LMW13(6-8)	2LMW14S(5-7)	2LMW17(0-2)	2LMW17(4-8)	2LMW18S(0-2)
DEPTH (feet):	2 - 4	2 - 4	6 - 8	5 - 7	0 - 2	4 - 8	0 - 2
LOCATION:	2LMW13S	2LMW13S	2LMW13S	2LMW14S	2LMW17S	2LMW17S	2LMW18S
SAMPLE DATE:	08/22/90	08/22/90	08/22/90	08/02/90	08/15/90	08/15/90	08/07/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

BORON	46.0 R	47.0 R	48.0 R	50.0 R	43.0 R	45.0 R	50.0 R
CADMIUM	4.3	4.8	4.9	3.7 J	3.3	6.9	2.7
CALCIUM	1170 J	1130 J	1410 J	856 J	1320	971	1690 J
CHROMIUM	19.8 J	22.0 J	22.7 J	18.9 J	14.4 J	17.3 J	16.2
COBALT	6.8	6.8	7.2	5.7 J	6.5	4.5 U	6.6
COPPER	15.8 J	17.8 J	18.2 J	12.4 J	31.2 J	45.5 J	103 J
CYANIDE	1.4 U	1.5 U	1.5 U	1.5 UJ	1.4 U	1.4 U	1.3 U
IRON	12600	13100	13700	11500 J	10900	8260	9890 J
LEAD	5.9 J	5.9 J	5.5 J	6.8 J	18.1 J	25.3 J	95.8 J
MAGNESIUM	3410	3370	3900	2460 J	3440	1740	2250 J
MANGANESE	133 J	134 J	157 J	74.0 J	144 J	101 J	132 J
MERCURY	0.11 U	0.11 U	0.11 U	0.12 U	0.09 U	3.6	0.11 U
NICKEL	13.2 J	16.2 J	14.2 J	12.4 J	15.6 J	12.4 J	36.3 J
POTASSIUM	1420 J	1400 J	1340 J	549 J	1770 J	861 J	1250
SELENIUM	0.46 U	0.47 U	0.48 U	0.48 UJ	0.42 U	0.45 U	0.41 U
SILVER	3.1 J	1.9 U	1.9 U	2.0 UR	1.7 UJ	1.8 UJ	1.7 U
SODIUM	115 J	205 J	152 J	110 J	210 J	211 J	108 J
THALLIUM	0.92 U	0.94 U	0.95 U	0.96 UJ	0.83 U	0.91 U	0.82 U
VANADIUM	28.3	29.8	33.0	24.9 J	24.4	13.9	36.2
ZINC	45.5 J	32.9 J	50.0 J	27.5 J	75.6 J	93.8 J	349 J

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LMW18S(2-6)	2LMW7(7-10)	2LMW8S(6-10)	2LMW9(2-8)	2LMW9(0-4)	2LMW19(0-4)	2LSS1
DEPTH (feet):	2 - 6	7 - 10	6 - 10	2 - 8	0 - 4	0 - 4	0 - 0.5
LOCATION:	2LMW18S	2LMW7S	2LMW8S	2LMW9S	2LMW9S	2LMW9S	2LSS1
SAMPLE DATE:	08/07/90	08/15/90	08/02/90	08/16/90	08/17/90	08/17/90	11/28/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
1,1,2,2-TETRACHLOROETHANE	5 U	5 U	37 U	5 U	5 U	6 U	2600 U
1,1,2-TRICHLOROETHANE	5 U	5 U	37 U	5 U	5 U	6 U	2600 U
2-BUTANONE	11 U	11 U	75 U	11 U	11 U	11 U	5300 U
4-METHYL-2-PENTANONE	12	11 U	75 U	11 U	11 U	11 U	5300 U
ACETONE	58	11 U	75 U	11 U	11 U	11 U	5300 U
CARBON DISULFIDE	5 J	5 U	37 U	5 U	5 U	6 U	2600 U
CHLOROBENZENE	5 U	5 U	37 U	5 U	5 U	6 U	4500
ETHYLBENZENE	15	5 U	37 U	5 U	5 U	6 U	14000
METHYLENE CHLORIDE	1 J	5 U	37 U	5 U	5 U	6 U	2600 U
TETRACHLOROETHENE	5 U	5 U	37 U	5 U	5 U	6 U	2600 U
TOLUENE	5 U	5 U	11 J	5 U	5 U	6 U	2600 U
TRICHLOROETHENE	5 U	5 U	37 U	5 U	5 U	6 U	2600 U
XYLENES, TOTAL	180	5 U	37 U	5 U	5 U	6 U	75000
SEMIVOLATILES (UG/KG)							
2,4-DIMETHYLPHENOL	1800 U	350 U	490 U	1800 U	1800 U	3700 U	340 U
2-METHYLNAPHTHALENE	1800 U	350 U	53 J	1800 U	1800 U	3700 U	340 U
4-METHYLPHENOL	1800 U	350 U	490 U	1800 U	1800 U	3700 U	340 U
ACENAPHTHENE	1800 U	350 U	50 J	1800 U	1800 U	3700 U	340 U
ACENAPHTHYLENE	1800 U	350 U	490 U	1800 U	1800 U	3700 U	340 U
ANTHRACENE	230 J	350 U	260 J	1800 U	1800 U	3700 U	340 U
BENZO(A)ANTHRACENE	370 J	99 J	290 J	490 J	570 J	360 J	130 J
BENZO(A)PYRENE	310 J	350 U	250 J	1800 U	1800 U	430 J	340 U
BENZO(B)FLUORANTHENE	1800 U	70 J	260 J	280 J	1800 U	370 J	220 J
BENZO(G,H,I)PERYLENE	1800 U	350 U	490 U	1800 U	1800 U	3700 U	340 U
BENZO(K)FLUORANTHENE	1800 U	120 J	210 J	560 J	1800 U	640 J	96 J
BIS(2-ETHYLHEXYL)PHTHALATE	1500 J	1200 U	990	1900	1800 U	3700 U	350 U
CHRYSENE	350 J	100 J	380 J	460 J	460 J	410 J	160 J
DI-N-BUTYL PHTHALATE	1800 U	76 J	490 U	1800 U	1800 U	3700 U	340 U
DIBENZOFURAN	1800 U	350 U	83 J	1800 U	1800 U	3700 U	340 U
FLUORANTHENE	940 J	170 J	780	600 J	670 J	750 J	160 J

TABLE 6-4

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LMW18S(2-6)	2LMW7(7-10)	2LMW8S(6-10)	2LMW9(2-8)	2LMW9(0-4)	2LMW19(0-4)	2LSS1
DEPTH (feet):	2 - 6	7 - 10	6 - 10	2 - 8	0 - 4	0 - 4	0 - 0.5
LOCATION:	2LMW18S	2LMW7S	2LMW8S	2LMW9S	2LMW9S	2LMW9S	2LSS1
SAMPLE DATE:	08/07/90	08/15/90	08/02/90	08/16/90	08/17/90	08/17/90	11/28/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
SEMIVOLATILES (UG/KG)							
FLUORENE	1800 U	350 U	130 J	1800 U	1800 U	3700 U	340 U
INDENO(1,2,3-CD)PYRENE	1800 U	350 U	490 U	1800 U	1800 U	3700 U	340 U
NAPHTHALENE	360 J	350 U	120 J	1800 U	1800 U	3700 U	340 U
PHENANTHRENE	780 J	140 J	680	380 J	390 J	410 J	66 J
PYRENE	820 J	200 J	550	680 J	970 J	590 J	110 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	24 J	190	190 J	170 U	180 U	180 U	17 U
4,4'-DDE	24 J	16 J	80 U	170 U	180 U	180 U	17 U
4,4'-DDT	83 J	47 J	80 U	170 U	180 U	180 U	71 J
ALDRIN	8.6 U	83 U	40 U	86 U	91 U	90 U	8.6 U
ALPHA-CHLORDANE	86 U	830 U	400 U	860 U	910 U	900 U	86 U
AROCLOR-1242	86 U	830 U	400 U	860 U	910 U	900 U	86 U
AROCLOR-1248	86 U	830 U	400 U	860 U	910 U	900 U	86 U
AROCLOR-1254	170 U	1700 U	800 U	1700 U	1800 U	1800 U	170 U
AROCLOR-1260	170 U	1700 U	800 U	1700 U	1800 U	1800 U	350 J
DIELDRIN	17 U	170 U	80 U	170 U	180 U	180 U	17 U
ENDOSULFAN II	17 U	170 U	80 U	170 U	180 U	180 U	17 U
ENDOSULFAN-I	8.6 U	83 U	40 U	86 U	91 U	90 U	8.6 U
ENDRIN	17 U	170 U	80 U	170 U	180 U	180 U	17 U
ENDRIN KETONE	17 U	170 U	80 U	170 U	180 U	180 U	17 U
GAMMA-CHLORDANE	86 U	830 U	400 U	860 U	910 U	900 U	86 U
HEPTACHLOR	8.6 U	83 U	40 U	86 U	91 U	90 U	8.6 U
HEPTACHLOR EPOXIDE	8.6 U	83 U	40 U	86 U	91 U	90 U	8.6 U
METHOXYCHLOR	86 U	830 U	400 U	860 U	910 U	900 U	86 U
INORGANICS (MG/KG)							
ALUMINUM	7790	4450	9680 J	6470	7020	7130	6160
ANTIMONY	15.7 UJ	12.2 UJ	15.6 UR	12.5 UJ	12.8 U	13.2 U	5.3 UR
ARSENIC	1.9 J	1.2	8.0 J	1.9	2.2	1.6	2.0
BARIUM	116	25.4	42.5 J	47.2	62.3	79.5	56.4
BERYLLIUM	3.9	0.25	0.53 J	1.2	3.0	2.1	1.5 J

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LMW18S(2-6)	2LMW7(7-10)	2LMW8S(6-10)	2LMW9(2-8)	2LMW9(0-4)	2LMW19(0-4)	2LSS1
DEPTH (feet):	2 - 6	7 - 10	6 - 10	2 - 8	0 - 4	0 - 4	0 - 0.5
LOCATION:	2LMW18S	2LMW7S	2LMW8S	2LMW9S	2LMW9S	2LMW9S	2LSS1
SAMPLE DATE:	08/07/90	08/15/90	08/02/90	08/16/90	08/17/90	08/17/90	11/28/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
INORGANICS (MG/KG)							
BORON	130 R	41.0 R	1882 R	52.0 R	45.0 R	82.0 R	43.0 R
CADMIUM	6.2	2.3	12.1 J	4.3	4.5	6.0	4.4
CALCIUM	3680 J	2140	5800 J	1650	1990	2590	1900
CHROMIUM	31.2	8.8 J	40.2 J	19.6 J	15.7 J	23.1 J	21.2
COBALT	20.5	4.3	8.5 J	14.9	23.8	22.0	8.1
COPPER	507 J	14.1 J	30.0 J	210	378	300	120
CYANIDE	1.6 U	1.3 U	1.8 UJ	1.4 U	1.4 U	1.4 U	1.3 U
IRON	20000 J	8370	49700 J	12300	15200	17700	12800
LEAD	277 J	7.6 J	32.9 J	114 J	118 J	160 J	85.7
MAGNESIUM	2310 J	2550	5020 J	2660	2970	2570	2160
MANGANESE	288 J	109 J	332 J	241 J	228	244	151
MERCURY	0.47	0.1 U	0.14 U	0.1 U	0.1 U	0.11 U	0.11 U
NICKEL	159 J	9.6 J	24.9 J	44.6 J	76.2 J	55.7 J	29.8
POTASSIUM	1230	902 J	2370 J	782 J	1120 J	1120 J	935 J
SELENIUM	0.5 U	0.41 U	0.77 J	0.43 U	0.43 U	0.44 U	0.47 J
SILVER	2.69 U	1.6 UJ	2.1 UR	1.7 UJ	1.7 U	1.8 U	1.5 U
SODIUM	427 J	220 J	600 J	273 J	306 J	363 J	204 J
THALLIUM	1.0 U	0.82 U	1.1 UJ	0.87 U	0.85 U	0.88 U	0.43 U
VANADIUM	24.5	16.2	30.6 J	17.4	19.6	20.0	19.7
ZINC	2640 J	30.0 J	229 J	902 J	1480 J	2450 J	299

TABLE 6-4

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LSS2	2LSS20 (0-1)	2LSS30 (0-1)	2LSS21 (0-1)	2LSS22 (0-1)	2LSS23 (0-1)	2LSS24 (0-1)
DEPTH (feet):	0 - 0.5	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
LOCATION:	2LSS2	2LSS20	2LSS20	2LSS21	2LSS22	2LSS23	2LSS24
SAMPLE DATE:	11/28/90	03/28/94	03/28/94	03/28/94	03/28/94	03/28/94	03/28/94
INVESTIGATION:	PH1	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

1,1,2,2-TETRACHLOROETHANE	5 U	11 U	12 U	12 U	11 U	11 U	11 U
1,1,2-TRICHLOROETHANE	5 U	11 U	12 U	12 U	11 U	11 U	11 U
2-BUTANONE	2 J	11 U	12 U	12 U	11 U	11 U	11 U
4-METHYL-2-PENTANONE	11 U	11 U	12 U	12 U	11 U	11 U	11 U
ACETONE	11 U	9 J	13	14	12	15	11 U
CARBON DISULFIDE	5 U	11 U	12 U	12 U	11 U	11 U	11 U
CHLOROBENZENE	43 J	11 U	12 U	12 U	11 U	11 U	11 U
ETHYLBENZENE	2 J	11 U	12 U	12 U	11 U	11 U	11 U
METHYLENE CHLORIDE	3 J	5 J	6 J	6 J	5 J	6 J	5 J
TETRACHLOROETHENE	4 J	11 U	12 U	12 U	11 U	11 U	11 U
TOLUENE	5 U	11 U	12 U	12 U	11 U	11 U	11 U
TRICHLOROETHENE	2 J	11 U	12 U	12 U	11 U	11 U	11 U
XYLENES, TOTAL	4 J	11 U	12 U	12 U	11 U	11 U	11 U

SEMIVOLATILES (UG/KG)

2,4-DIMETHYLPHENOL	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
2-METHYLNAPHTHALENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
4-METHYLPHENOL	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
ACENAPHTHENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
ACENAPHTHYLENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
ANTHRACENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
BENZO(A)ANTHRACENE	9300 U	380 U	380 U	400 U	380 U	120 J	360 U
BENZO(A)PYRENE	9300 U	380 U	380 U	400 U	380 U	140 J	360 U
BENZO(B)FLUORANTHENE	9300 U	380 U	380 U	400 U	380 U	170 J	360 U
BENZO(G,H,I)PERYLENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
BENZO(K)FLUORANTHENE	9300 U	380 U	380 U	400 U	380 U	89 J	360 U
BIS(2-ETHYLHEXYL)PHTHALATE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
CARBAZOLE		380 U	380 U	400 U	380 U	380 U	360 U
CHRYSENE	9300 U	380 U	380 U	400 U	380 U	120 J	360 U
DI-N-BUTYL PHTHALATE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
DIBENZOFURAN	9300 U	380 U	380 U	400 U	380 U	380 U	360 U

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LSS2	2LSS20 (0-1)	2LSS30 (0-1)	2LSS21 (0-1)	2LSS22 (0-1)	2LSS23 (0-1)	2LSS24 (0-1)
DEPTH (feet):	0 - 0.5	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
LOCATION:	2LSS2	2LSS20	2LSS20	2LSS21	2LSS22	2LSS23	2LSS24
SAMPLE DATE:	11/28/90	03/28/94	03/28/94	03/28/94	03/28/94	03/28/94	03/28/94
INVESTIGATION:	PH1	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
SEMIVOLATILES (UG/KG)							
FLUORANTHENE	9300 U	380 U	380 U	400 U	140 J	230 J	360 U
FLUORENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
INDENO(1,2,3-CD)PYRENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
NAPHTHALENE	9300 U	380 U	380 U	400 U	380 U	380 U	360 U
PHENANTHRENE	9300 U	380 U	380 U	400 U	380 U	150 J	360 U
PYRENE	1100 J	380 U	380 U	400 U	160 J	270 J	360 U
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	170 U	3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
4,4'-DDE	170 U	3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
4,4'-DDT	2300 J	3.9 U	3.9 U	4 U	3.8 U	6.8	3.7 U
ALDRIN	86 U	2 U	2 U	2.1 U	2 U	2 U	1.9 U
ALPHA-CHLORDANE	860 U	2 U	2 U	2.1 U	2 U	2 U	1.9 U
AROCLOR-1242	860 U	39 U	39 U	40 U	38 U	39 U	37 U
AROCLOR-1248	860 U	39 U	39 U	40 U	38 U	39 U	37 U
AROCLOR-1254	1700 U	39 U	39 U	40 U	15 J	20 J	37 U
AROCLOR-1260	12000	39 U	39 U	40 U	38 U	39 U	37 U
DIELDRIN	170 U	3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
ENDOSULFAN II	170 U	3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
ENDOSULFAN-I	86 U	2 U	2 U	2.1 U	2 U	2 U	1.9 U
ENDRIN	170 U	3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
ENDRIN ALDEHYDE		3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
ENDRIN KETONE	570	3.9 U	3.9 U	4 U	3.8 U	3.9 U	3.7 U
GAMMA-CHLORDANE	860 U	2 U	2 U	2.1 U	2 U	2 U	1.9 U
HEPTACHLOR	86 U	2 U	2 U	2.1 U	2 U	2 U	1.9 U
HEPTACHLOR EPOXIDE	86 U	2 U	2 U	2.1 U	2 U	2 U	1.9 U
METHOXYCHLOR	860 U	20 U	20 U	21 U	20 U	20 U	19 U
INORGANICS (MG/KG)							
ALUMINUM	5910	7150	5680	12200	6180	8220	8580
ANTIMONY	5.3 UR	2.6 U	2.3 U	3.2 U	2.9 U	3.0 U	2.4 U
ARSENIC	1.1	0.5	0.59	2.2	1.2	1.9	1.1

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TABLE 6-4

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LSS2	2LSS20 (0-1)	2LSS30 (0-1)	2LSS21 (0-1)	2LSS22 (0-1)	2LSS23 (0-1)	2LSS24 (0-1)
DEPTH (feet):	0 - 0.5	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
LOCATION:	2LSS2	2LSS20	2LSS20	2LSS21	2LSS22	2LSS23	2LSS24
SAMPLE DATE:	11/28/90	03/28/94	03/28/94	03/28/94	03/28/94	03/28/94	03/28/94
INVESTIGATION:	PH1	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

BARIUM	53.7	54.5	49.1	36.6	38.8	48.1	42.5
BERYLLIUM	0.53 J	0.31	0.24	0.5	0.36	0.34	0.37
BORON	42.0 R	2.9 U	2.6 U	3.6 U	3.3 U	3.4 U	2.7 U
CADMIUM	3.9	0.35 U	0.31 U	0.43 U	0.39 U	0.41 U	0.33 U
CALCIUM	1610	1300	1100	794	1500	6090	989
CHROMIUM	15.6	8.2	6.5	12.7	9.2	10.7	9.7
COBALT	5.6	5.7	4.6	5.2	4.5	5.4	5.3
COPPER	56.7 J	4.3	3.1	7.3	15.5	9.4	6.2
CYANIDE	1.2 U	0.11 U	0.1 U	0.11 U	0.09	0.11 U	0.09 U
IRON	11800	10100	7960	11700	7660	10100	10200
LEAD	36.2	5.0	4.9	7.4	13.6	15.9	5.0
MAGNESIUM	1990	3960	3070	2610	2320	2990	3120
MANGANESE	136	247	213	145	177	179	254
MERCURY	0.11 U	0.02 U	0.02 U	0.04 U	0.04 U	0.03	0.03 U
NICKEL	26.7	5.6	4.9	7.6	7.4	7.2	5.9
POTASSIUM	1050 J	3110	2370	1270	1470	1830	1930
SELENIUM	0.36 J	0.28 U	0.25 U	0.35 U	0.32 U	0.33 U	0.26 U
SILVER	1.5 U	0.59 U	0.53 U	0.74 U	0.68 U	0.7 U	0.56 U
SODIUM	170 J	37.4	33.6	34.3	42.5	113	38.6
THALLIUM	0.43 U	0.46 U	0.41 U	0.57 U	0.53 U	0.55 U	0.44 U
VANADIUM	23.9	17.9	15.0	24.5	15.6	19.7	18.0
ZINC	128	34.0	29.6	24.5	74.4	46.6	28.7

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB13 (0-2)	2LTB13-0001	2LTB13-0001A(FIELD)	2LTB13-0102(FIELD)	2LTB13-0204(FIELD)	2LTB13-0406(FIELD)	2LTB13-0608(FIELD)
DEPTH (feet):	0 - 2	0 - 1	0 - 1	1 - 2	2 - 4	4 - 6	6 - 8
LOCATION:	2LTB13-FFS	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2
SAMPLE DATE:	11/09/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93
INVESTIGATION:	FFS	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

1,1,2,2-TETRACHLOROETHANE	11 U						
1,1,2-TRICHLOROETHANE	11 U						
2-BUTANONE	11 U						
4-METHYL-2-PENTANONE	11 U						
ACETONE	24 U						
CARBON DISULFIDE	11 U						
CHLOROBENZENE	11 U						
ETHYLBENZENE	11 U						
METHYLENE CHLORIDE	12 U						
TETRACHLOROETHENE	11 U						
TOLUENE	11 U						
TRICHLOROETHENE	11 U						
XYLENES, TOTAL	11 U						

SEMIVOLATILES (UG/KG)

2,4-DIMETHYLPHENOL	350 U						
2-METHYLNAPHTHALENE	350 U						
4-METHYLPHENOL	350 U						
ACENAPHTHENE	350 U						
ACENAPHTHYLENE	350 U						
ANTHRACENE	350 U						
BENZO(A)ANTHRACENE	350 U						
BENZO(A)PYRENE	350 U						
BENZO(B)FLUORANTHENE	350 U						
BENZO(G,H,I)PERYLENE	350 U						
BENZO(K)FLUORANTHENE	350 U						
BIS(2-ETHYLHEXYL)PHTHALATE	350 U						
CARBAZOLE	350 U						
CHRYSENE	350 U						
DI-N-BUTYL PHTHALATE	350 U						
DIBENZOFURAN	350 U						

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TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB13 (0-2)	2LTB13-0001	2LTB13-0001A(FIELD)	2LTB13-0102(FIELD)	2LTB13-0204(FIELD)	2LTB13-0406(FIELD)	2LTB13-0608(FIELD)
DEPTH (feet):	0 - 2	0 - 1	0 - 1	1 - 2	2 - 4	4 - 6	6 - 8
LOCATION:	2LTB13-FFS	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2
SAMPLE DATE:	11/09/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93
INVESTIGATION:	FFS	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
SEMIVOLATILES (UG/KG)							
FLUORANTHENE	350 U						
FLUORENE	350 U						
INDENO(1,2,3-CD)PYRENE	350 U						
NAPHTHALENE	350 U						
PHENANTHRENE	350 U						
PYRENE	350 U						
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	96 J						
4,4'-DDE	45 J						
4,4'-DDT	110 J						
ALDRIN	3.6 UJ						
ALPHA-CHLORDANE	12 J						
AROCLOR-1242	69 UJ						
AROCLOR-1248	69 UJ		780	94	62	130	51
AROCLOR-1254	220 J		263.6 U	200	110	241.08 U	130
AROCLOR-1260	69 UJ						
DIELDRIN	6.9 UJ						
ENDOSULFAN II	6.9 UJ						
ENDOSULFAN-I	3.6 UJ						
ENDRIN	6.9 UJ						
ENDRIN ALDEHYDE	6.9 UJ						
ENDRIN KETONE	6.9 UJ						
GAMMA-CHLORDANE	12 J						
HEPTACHLOR	3.6 UJ						
HEPTACHLOR EPOXIDE	3.6 UJ						
METHOXYCHLOR	36 UJ						
DIOXINS/FURANS (UG/KG)							
1,2,3,4,6,7,8-HPCDF	0.301 U	0.08 UJ					
1,2,3,4,7,8-HXCDF	0.334 U	0.2 UJ					
1,2,3,6,7,8-HXCDF	0.055 U	0.19 UJ					

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB13 (0-2)	2LTB13-0001	2LTB13-0001A(FIELD)	2LTB13-0102(FIELD)	2LTB13-0204(FIELD)	2LTB13-0406(FIELD)	2LTB13-0608(FIELD)
DEPTH (feet):	0 - 2	0 - 1	0 - 1	1 - 2	2 - 4	4 - 6	6 - 8
LOCATION:	2LTB13-FFS	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2	2LTB13-PH2
SAMPLE DATE:	11/09/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93
INVESTIGATION:	FFS	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
DIOXINS/FURANS (UG/KG)							
OCDD	1.592	2.5 J					
INORGANICS (MG/KG)							
ALUMINUM	5450						
ANTIMONY	3.6 UJ						
ARSENIC	0.95 UJ						
BARIUM	43.1 J						
BERYLLIUM	0.83						
BORON	2.6 U						
CADMIUM	0.91 J						
CALCIUM	1490						
CHROMIUM	12.1 J						
COBALT	8.0						
COPPER	101 J						
CYANIDE	0.09 U						
IRON	10300						
LEAD	119						
MAGNESIUM	2400						
MANGANESE	134 J						
MERCURY	0.22						
NICKEL	26.0 J						
POTASSIUM	1330						
SELENIUM	0.22 UJ						
SILVER	0.41 U						
SODIUM	421						
THALLIUM	0.26 U						
VANADIUM	17.3						
ZINC	270 J						

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TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB16 (0-2)	2LTB17 (0-2)	2LTB18 (0-2)	2LTB19 (2-4)	2LTB19 (4-6)	2LTB2(2-8)	2LTB20 (6-8)
DEPTH (feet):	0 - 2	0 - 2	0 - 2	2 - 4	4 - 6	2 - 8	6 - 8
LOCATION:	2LTB16	2LTB17	2LTB18	2LTB19	2LTB19	2LTB2	2LTB20
SAMPLE DATE:	11/04/93	11/03/93	11/02/93	11/10/93	11/14/93	08/16/90	11/09/93
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	PH1	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

1,1,2,2-TETRACHLOROETHANE	12 U	11 U	10 U	11 U		28 U	3000 U
1,1,2-TRICHLOROETHANE	12 U	11 U	10 U	11 U		28 U	3000 U
2-BUTANONE	12 U	12 U	13 U	11 U		57 U	3000 U
4-METHYL-2-PENTANONE	12 U	11 U	10 U	11 U		57 U	3000 U
ACETONE	65 UJ	71 UJ	75 UJ	44 U		250 J	3000 U
CARBON DISULFIDE	12 U	11 U	10 U	11 U		28 U	3000 U
CHLOROBENZENE	12 U	11 U	10 U	11 U		28 U	3000 U
ETHYLBENZENE	5 J	11 U	10 U	11 U		68 J	7700
METHYLENE CHLORIDE	12 U	11 U	10 U	25		28 U	3000 U
TETRACHLOROETHENE	12 U	11 U	10 U	11 U		28 U	3000 U
TOLUENE	16	10 J	4 J	11 U		6 J	3000 U
TRICHLOROETHENE	12 U	11 U	10 U	11 U		28 U	3000 U
XYLENES, TOTAL	12 U	11 U	8 J	7 J		690 J	8800

SEMIVOLATILES (UG/KG)

2,4-DIMETHYLPHENOL	9300 UJ	11000 UJ	9900 U	350 U		7500 U	12000 U
2-METHYLNAPHTHALENE	9300 UJ	11000 UJ	9900 U	430		1300 J	12000 U
4-METHYLPHENOL	9300 UJ	11000 UJ	9900 U	340 J		7500 U	12000 U
ACENAPHTHENE	9300 UJ	11000 UJ	9900 U	620		7500 U	8400 J
ACENAPHTHYLENE	9300 UJ	11000 UJ	9900 U	350 U		7500 U	12000 U
ANTHRACENE	9300 UJ	11000 UJ	9900 U	500		7500 U	19000
BENZO(A)ANTHRACENE	9300 UJ	11000 UJ	9900 U	950		7500 U	23000
BENZO(A)PYRENE	9300 UJ	11000 UJ	9900 U	750		7500 U	15000
BENZO(B)FLUORANTHENE	9300 UJ	11000 UJ	9900 U	860		7500 U	15000
BENZO(G,H,I)PERYLENE	9300 UJ	11000 UJ	9900 U	260 J		7500 U	12000 U
BENZO(K)FLUORANTHENE	9300 UJ	11000 UJ	9900 U	540		7500 U	14000 J
BIS(2-ETHYLHEXYL)PHTHALATE	9300 UJ	11000 UJ	9900 U	480		1000 U	12000 U
CARBAZOLE	9300 UJ	11000 UJ	9900 U	410			9800 J
CHRYSENE	9300 UJ	11000 UJ	9900 U	920		7500 U	19000
DI-N-BUTYL PHTHALATE	9300 UJ	11000 UJ	9900 U	350 U		7500 U	12000 U
DIBENZOFURAN	9300 UJ	11000 UJ	9900 U	490		7500 U	13000

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB16 (0-2)	2LTB17 (0-2)	2LTB18 (0-2)	2LTB19 (2-4)	2LTB19 (4-6)	2LTB2 (2-8)	2LTB20 (6-8)
DEPTH (feet):	0 - 2	0 - 2	0 - 2	2 - 4	4 - 6	2 - 8	6 - 8
LOCATION:	2LTB16	2LTB17	2LTB18	2LTB19	2LTB19	2LTB2	2LTB20
SAMPLE DATE:	11/04/93	11/03/93	11/02/93	11/10/93	11/14/93	08/16/90	11/09/93
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	PH1	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

SEMIVOLATILES (UG/KG)

FLUORANTHENE	9300 UJ	11000 UJ	9900 U	1800		7500 U	47000
FLUORENE	9300 UJ	11000 UJ	9900 U	790		7500 U	17000
INDENO(1,2,3-CD)PYRENE	9300 UJ	11000 UJ	9900 U	230 J		7500 U	12000 U
NAPHTHALENE	9300 UJ	11000 UJ	9900 U	1000		7500 U	20000
PHENANTHRENE	9300 UJ	11000 UJ	9900 U	1800		860 J	61000
PYRENE	9300 UJ	11000 UJ	9900 U	1700		7500 U	40000

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	79 J	110	110 UJ	180 J		180 U	34 J
4,4'-DDE	20 J	28 J	67 J	140 J		180 U	4.1 U
4,4'-DDT	7.3 UJ	12 J	3.5 U	14 J		180 U	13 J
ALDRIN	0.56 J	1.9 U	1.8 UJ	1.8 U		91 U	2.1 U
ALPHA-CHLORDANE	39 J	16 J	1.8 UJ	1.8 U		910 U	2.1 U
AROCLOR-1242	37 UJ	36 U	35 UJ	35 U		910 U	41 U
AROCLOR-1248	37 UJ	36 U	35 UJ	35 U		910 U	41 U
AROCLOR-1254	150 J	87 J	490 J	920 J		1800 U	300 J
AROCLOR-1260	230 J	36 U	35 U	35 U		1800 U	41 U
DIELDRIN	4.4 J	4.5 J	3.5 UJ	3.5 U		180 U	4.1 U
ENDOSULFAN II	3.7 UJ	2 J	3.5 U	3.5 U		180 U	4.1 U
ENDOSULFAN-I	1.9 UJ	1.9 U	1.8 UJ	1.8 U		91 U	2 J
ENDRIN	2.4 J	0.89 J	3.5 U	3.7 J		180 U	3.9 J
ENDRIN ALDEHYDE	3.7 UJ	19 J	3.5 U	3.5 U			91
ENDRIN KETONE	3.7 UJ	3.6 U	3.5 U	3.5 U		180 U	5.9 J
GAMMA-CHLORDANE	61 J	11 J	1.8 UJ	1.8 U		910 U	2.1 U
HEPTACHLOR	1.9 UJ	1.9 U	1.8 U	0.51 J		91 U	2.1 U
HEPTACHLOR EPOXIDE	1.9 UJ	1.9 U	1.8 UJ	1.8 U		91 U	0.66 J
METHOXYCHLOR	19 UJ	19 J	18 U	18 U		910 U	21 U

INORGANICS (MG/KG)

ALUMINUM	8710	5990	5150	7000		7470	7140
ANTIMONY	3.2 UJ	17.7 UJ	14.3 UJ	44.6 J		13.3 UJ	58.8 J
ARSENIC	2.0 J	1.5 UJ	2.7	2.1 J		4.5	5.0 J

TABLE 6-4

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB16 (0-2)	2LTB17 (0-2)	2LTB18 (0-2)	2LTB19 (2-4)	2LTB19 (4-6)	2LTB2(2-8)	2LTB20 (6-8)
DEPTH (feet):	0 - 2	0 - 2	0 - 2	2 - 4	4 - 6	2 - 8	6 - 8
LOCATION:	2LTB16	2LTB17	2LTB18	2LTB19	2LTB19	2LTB2	2LTB20
SAMPLE DATE:	11/04/93	11/03/93	11/02/93	11/10/93	11/14/93	08/16/90	11/09/93
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	PH1	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

BARIUM	49.0 J	199 J	87.4	115 J		75.4	103 J
BERYLLIUM	0.44	1.9	2.2	0.63		0.4	1.5
BORON	2.7 U	10.3 U	11.6 U	14.9 U		44.0 R	9.4 U
CADMIUM	1.5 J	4.7 J	3.5	2.2 J		3.5	0.56 J
CALCIUM	4680	5580	3560 J	8140		1750	7520
CHROMIUM	14.0 J	26.5 J	18.1	31.4 J		17.5 J	30.0 J
COBALT	6.4	14.7	10.4	7.7		5.9	6.6
COPPER	47.9 J	345 J	871 J	815 J		69.5 J	174 J
CYANIDE	0.08	0.22	0.1 J	0.09 U		1.4 U	0.11 U
IRON	12400	15600	12200 J	26400		12500	29500
LEAD	38.2	449	244 J	307		170 J	663
MAGNESIUM	2960	3570	2120	1910		2980	1570
MANGANESE	176 J	277 J	285 J	465 J		149 J	216 J
MERCURY	0.09 U	0.24 U	0.61	0.24		0.1 U	0.02 U
NICKEL	10.0 J	47.8 J	31.8	81.4 J		15.4 J	58.9 J
POTASSIUM	1560	1310	1120	1080		2150 J	994
SELENIUM	0.23 UJ	0.34 UJ	0.46 U	0.46 UJ		0.44 U	0.21 UJ
SILVER	0.38 U	2.3 U	1.3 UJ	38.9		1.8 UJ	0.26 U
SODIUM	441	2030	354	4120		268 J	367 J
THALLIUM	0.28 U	0.4 U	0.44 U	0.29 U		0.88 U	0.24 UJ
VANADIUM	23.5	31.7	16.4 J	16.8 J		20.7	138
ZINC	81.2 J	1020 J	5340	975 J		149 J	499 J

MISCELLANEOUS PARAMETERS ()

ASH (%)		92			93.5		
CATION EX. CAPACITY (meq/100g)		4.9			3.9		
PH		8.08 J			8.56 J		
SPECIFIC GRAVITY (g/cm3)		2.4			2.3		
TOTAL ORGANIC CARBON (MG/KG)		4500			2900		

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB22 (6-8)	2LTB22 (8-10)	2LTB23 (4-8)	2LTB33 (4-8)	2LTB23-0002(FIELD)	2LTB23-0406	2LTB23-0406(FIELD)
DEPTH (feet):	6 - 8	8 - 10	4 - 8	4 - 8	0 - 2	4 - 6	4 - 6
LOCATION:	2LTB22	2LTB22	2LTB23-FFS	2LTB23-FFS	2LTB23-PH2	2LTB23-PH2	2LTB23-PH2
SAMPLE DATE:	11/05/93	11/02/93	11/08/93	11/08/93	12/03/93	12/03/93	12/03/93
INVESTIGATION:	FFS	FFS	FFS	FFS	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

1,1,2,2-TETRACHLOROETHANE	17 U		3300 U	4500 U			
1,1,2-TRICHLOROETHANE	17 U		3300 U	4500 U			
2-BUTANONE	19 U		3300 U	4500 U			
4-METHYL-2-PENTANONE	17 U		3300 U	4500 U			
ACETONE	80 UJ		3300 U	4500 U			
CARBON DISULFIDE	17 U		3300 U	4500 U			
CHLOROBENZENE	17 U		3300 U	4500 J			
ETHYLBENZENE	17 U		14000 J	28000			
METHYLENE CHLORIDE	22		3300 U	4500 U			
TETRACHLOROETHENE	17 U		3300 U	4500 U			
TOLUENE	27		1800 J	3200 J			
TRICHLOROETHENE	17 U		3300 U	4500 U			
XYLENES, TOTAL	17 U		75000 J	140000 J			

SEMIVOLATILES (UG/KG)

2,4-DIMETHYLPHENOL	2200 U		1500 UJ	190 J			
2-METHYLNAPHTHALENE	2200 U		1500 U	310 J			
4-METHYLPHENOL	2200 U		2000 J	820 J			
ACENAPHTHENE	2200 U		1500 U	370 U			
ACENAPHTHYLENE	2200 U		1500 U	370 U			
ANTHRACENE	2200 U		1500 U	370 U			
BENZO(A)ANTHRACENE	2400		1500 U	370 U			
BENZO(A)PYRENE	2100 J		1500 U	370 UJ			
BENZO(B)FLUORANTHENE	2400 J		1500 U	170 J			
BENZO(G,H,I)PERYLENE	2200 UJ		1500 U	370 UJ			
BENZO(K)FLUORANTHENE	1700 J		1500 U	130 J			
BIS(2-ETHYLHEXYL)PHTHALATE	2200 U		1500 U	370 U			
CARBAZOLE	2200 U		1500 U	370 U			
CHRYSENE	2600		1500 U	370 U			
DI-N-BUTYL PHTHALATE	2200 U		1500 U	370 U			
DIBENZOFURAN	2200 U		1500 U	370 U			

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB22 (6-8)	2LTB22 (8-10)	2LTB23 (4-8)	2LTB33 (4-8)	2LTB23-0002(FIELD)	2LTB23-0406	2LTB23-0406(FIELD)
DEPTH (feet):	6 - 8	8 - 10	4 - 8	4 - 8	0 - 2	4 - 6	4 - 6
LOCATION:	2LTB22	2LTB22	2LTB23-FFS	2LTB23-FFS	2LTB23-PH2	2LTB23-PH2	2LTB23-PH2
SAMPLE DATE:	11/05/93	11/02/93	11/08/93	11/08/93	12/03/93	12/03/93	12/03/93
INVESTIGATION:	FFS	FFS	FFS	FFS	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

SEMIVOLATILES (UG/KG)

FLUORANTHENE	4100		1500 U	230 J			
FLUORENE	2200 U		1500 U	370 U			
INDENO(1,2,3-CD)PYRENE	2200 UJ		1500 U	370 UJ			
NAPHTHALENE	2200 U		920 J	350 J			
PHENANTHRENE	3700		1500 U	310 J			
PYRENE	4900		1500 UJ	450 J			

PESTICIDES/PCBs (UG/KG)

4,4'-DDD		24 J	360 U	370 U			
4,4'-DDE		16	360 U	370 U			
4,4'-DDT		13 J	360 U	370 U			
ALDRIN		2 U	190 U	190 U			
ALPHA-CHLORDANE		2.4	190 U	190 U			
AROCLOR-1242		40 U	3600 U	3700 U			
AROCLOR-1248		40 U	3600 U	3700 U	35.86 U		3700
AROCLOR-1254		99 J	51000	100000 J	340		19400
AROCLOR-1260		40 U	3600 U	3700 U			
DIELDRIN		1.2 J	360 U	370 U			
ENDOSULFAN II		4 U	360 U	370 U			
ENDOSULFAN-I		2 U	190 UJ	340 J			
ENDRIN		4 U	470 J	200 J			
ENDRIN ALDEHYDE		4 U	360 U	370 U			
ENDRIN KETONE		4 U	360 U	370 U			
GAMMA-CHLORDANE		3 J	190 U	190 U			
HEPTACHLOR		2 U	79 J	190 U			
HEPTACHLOR EPOXIDE		2 U	190 U	190 U			
METHOXYCHLOR		20 U	1900 U	1900 U			

DIOXINS/FURANS (UG/KG)

1,2,3,4,6,7,8-HPCDF			0.254 U	0.246		0.16 U	
1,2,3,4,7,8-HXCDF			0.256 U	0.306		0.62 U	
1,2,3,6,7,8-HXCDF			0.742 U	0.153		0.58 U	

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB22 (6-8)	2LTB22 (8-10)	2LTB23 (4-8)	2LTB33 (4-8)	2LTB23-0002(FIELD)	2LTB23-0406	2LTB23-0406(FIELD)
DEPTH (feet):	6 - 8	8 - 10	4 - 8	4 - 8	0 - 2	4 - 6	4 - 6
LOCATION:	2LTB22	2LTB22	2LTB23-FFS	2LTB23-FFS	2LTB23-PH2	2LTB23-PH2	2LTB23-PH2
SAMPLE DATE:	11/05/93	11/02/93	11/08/93	11/08/93	12/03/93	12/03/93	12/03/93
INVESTIGATION:	FFS	FFS	FFS	FFS	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
DIOXINS/FURANS (UG/KG)							
OCDD			1.982 U	1.626		1.7 J	
INORGANICS (MG/KG)							
ALUMINUM	9000		7840	8970			
ANTIMONY	134 J		26.9 UJ	31.7 J			
ARSENIC	10.6 J		3.0 J	2.1 J			
BARIUM	420 J		667 J	272 J			
BERYLLIUM	1.7		0.84	1.7			
BORON	79.8		19.0 U	35.7			
CADMIUM	5.2 J		10.0 J	12.1 J			
CALCIUM	17200		9960	9760			
CHROMIUM	289 J		36.6 J	86.5 J			
COBALT	122		14.6	18.3			
COPPER	21600 J		3900 J	1710 J			
CYANIDE	0.25 U		0.27 U	0.35			
IRON	157000		21500	32000			
LEAD	1780		705	612			
MAGNESIUM	4780		6290	9330			
MANGANESE	1150 J		376 J	465 J			
MERCURY	0.47		1.1	1.2			
NICKEL	1440 J		63.4 J	89.6 J			
POTASSIUM	1490		1260	1310			
SELENIUM	0.36 UJ		0.93 UJ	0.72 UJ			
SILVER	12.6		12.2	9.6			
SODIUM	1610 J		3770	3950			
THALLIUM	2.1 U		0.31 UJ	0.28 U			
VANADIUM	73.2 J		32.6	41.4			
ZINC	9850 J		1550 J	1650 J			

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB23-0608(FIELD)	2LTB23-0810(FIELD)	2LTB23-1012(FIELD)	2LTB26 (4-6)	2LTB28 (4-6)	2LTB29 (10-12)	2LTB39 (10-12)
DEPTH (feet):	6 - 8	8 - 10	10 - 12	4 - 6	4 - 6	10 - 12	10 - 12
LOCATION:	2LTB23-PH2	2LTB23-PH2	2LTB23-PH2	2LTB26	2LTB28	2LTB29	2LTB29
SAMPLE DATE:	12/03/93	12/03/93	12/03/93	11/12/93	11/12/93	11/14/93	11/14/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
1,1,2,2-TETRACHLOROETHANE				11 U	12 U	12 U	12 U
1,1,2-TRICHLOROETHANE				11 U	12 U	12 U	12 U
2-BUTANONE				11 U	12 U	12 U	12 U
4-METHYL-2-PENTANONE				11 U	12 U	12 U	12 U
ACETONE				57 U	37 U	44 U	35 U
CARBON DISULFIDE				11 U	12 U	12 U	12 U
CHLOROBENZENE				11 U	12 U	12 U	12 U
ETHYLBENZENE				11 U	12 U	12 U	12 U
METHYLENE CHLORIDE				11 U	12 U	12 U	12 U
TETRACHLOROETHENE				11 U	12 U	12 U	12 U
TOLUENE				19	13	12 J	12 U
TRICHLOROETHENE				11 U	12 U	12 U	12 U
XYLENES, TOTAL				11 U	12 U	12 U	12 U
SEMIVOLATILES (UG/KG)							
2,4-DIMETHYLPHENOL				720 U	380 U	400 U	410 U
2-METHYLNAPHTHALENE				370 J	380 U	400 U	410 U
4-METHYLPHENOL				720 U	380 U	400 U	410 U
ACENAPHTHENE				750	380 U	400 U	410 U
ACENAPHTHYLENE				720 U	220 J	400 U	410 U
ANTHRACENE				1600	380 U	400 U	410 U
BENZO(A)ANTHRACENE				2800	610	510 J	930 J
BENZO(A)PYRENE				2100 J	620 J	530	780 J
BENZO(B)FLUORANTHENE				2400 J	840 J	550	780 J
BENZO(G,H,I)PERYLENE				590 J	230 J	320 J	310 J
BENZO(K)FLUORANTHENE				1600 J	530 J	400 J	630 J
BIS(2-ETHYLHEXYL)PHTHALATE				720 U	380 U	400 U	600 U
CARBAZOLE				970	380 U	400 U	410 U
CHRYSENE				2500	810	520	830
DI-N-BUTYL PHTHALATE				720 U	380 U	400 U	410 U
DIBENZOFURAN				690 J	380 U	400 U	410 U

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB23-0608(FIELD)	2LTB23-0810(FIELD)	2LTB23-1012(FIELD)	2LTB26 (4-6)	2LTB28 (4-6)	2LTB29 (10-12)	2LTB39 (10-12)
DEPTH (feet):	6 - 8	8 - 10	10 - 12	4 - 6	4 - 6	10 - 12	10 - 12
LOCATION:	2LTB23-PH2	2LTB23-PH2	2LTB23-PH2	2LTB26	2LTB28	2LTB29	2LTB29
SAMPLE DATE:	12/03/93	12/03/93	12/03/93	11/12/93	11/12/93	11/14/93	11/14/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

SEMIVOLATILES (UG/KG)

FLUORANTHENE				4800	1000	520 J	990 J
FLUORENE				1400	380 U	400 U	410 U
INDENO(1,2,3-CD)PYRENE				640 J	240 J	310 J	330 J
NAPHTHALENE				390 J	380 U	400 U	410 U
PHENANTHRENE				5700	570	400 UJ	460 J
PYRENE				4600	1200	650 J	1300 J

PESTICIDES/PCBs (UG/KG)

4,4'-DDD				9.6 J	490 J	360	2200 J
4,4'-DDE				4.2 J	270 J	220 J	280 J
4,4'-DDT				3.6 UJ	58 UJ	770 J	1300 J
ALDRIN				1.9 UJ	18 U	18 U	20 U
ALPHA-CHLORDANE				2 J	18 U	86	100
AROCLOR-1242				36 UJ	350 U	360 U	380 U
AROCLOR-1248	390	165	26.8 U	36 UJ	350 U	360 U	380 U
AROCLOR-1254	1360	520	26.8 U	49 J	8100	490 J	380 UJ
AROCLOR-1260				36 UJ	2500	360 U	380 U
DIELDRIN				3.6 UJ	35 U	27 J	35 J
ENDOSULFAN II				3.6 UJ	35 U	36 U	38 U
ENDOSULFAN-I				1.9 UJ	31 J	18 U	20 U
ENDRIN				3.6 UJ	20 J	36 U	38 U
ENDRIN ALDEHYDE				3.6 UJ	35 U	36 UJ	40 J
ENDRIN KETONE				3.6 UJ	35 U	36 U	38 U
GAMMA-CHLORDANE				1.9 UJ	18 U	84 J	95 J
HEPTACHLOR				1.9 UJ	5 J	18 U	20 U
HEPTACHLOR EPOXIDE				1.9 UJ	18 U	4.3 J	5.3 J
METHOXYCHLOR				19 UJ	180 U	180 U	200 U

INORGANICS (MG/KG)

ALUMINUM				6590	6840	8250	7410
ANTIMONY				7.3 UJ	17.6 UJ	56.7 J	59.0 J
ARSENIC				1.5 J	2.5	4.5 J	4.1 J

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB23-0608(FIELD)	2LTB23-0810(FIELD)	2LTB23-1012(FIELD)	2LTB26 (4-6)	2LTB28 (4-6)	2LTB29 (10-12)	2LTB39 (10-12)
DEPTH (feet):	6 - 8	8 - 10	10 - 12	4 - 6	4 - 6	10 - 12	10 - 12
LOCATION:	2LTB23-PH2	2LTB23-PH2	2LTB23-PH2	2LTB26	2LTB28	2LTB29	2LTB29
SAMPLE DATE:	12/03/93	12/03/93	12/03/93	11/12/93	11/12/93	11/14/93	11/14/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

BARIUM				55.3 J	65.8 J	233 J	223 J
BERYLLIUM				0.35	0.29	1.8	2.2
BORON				2.1 U	30.0	38.5	25.1
CADMIUM				0.68 J	1.4 J	3.1 J	2.8 J
CALCIUM				2510	2680	5590	3570
CHROMIUM				14.3 J	26.2 J	44.7 J	43.8 J
COBALT				6.1	6.8	23.5	19.8
COPPER				107 J	300 J	2830 J	2300 J
CYANIDE				0.1 U	0.1 U	0.74	0.42
IRON				11300	64400	67300	83300
LEAD				69.8	463	720	645
MAGNESIUM				2650	1880	2120	1990
MANGANESE				178 J	318 J	503 J	458 J
MERCURY				0.16	0.14	0.91	0.82
NICKEL				12.9 J	28.0 J	118 J	115 J
POTASSIUM				1780	1060	1110	1000
SELENIUM				0.33 UJ	0.2 UJ	0.13 UJ	0.19 UJ
SILVER				1.0 U	2.8	9.2	9.2
SODIUM				267 U	406 J	2770	2250
THALLIUM				0.25 U	0.24 UJ	0.76 U	0.77 U
VANADIUM				22.0	20.5 J	27.9 J	31.4 J
ZINC				190 J	378 J	4030 J	1980 J

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB31 (8-10)	2LTB9 (0-2)	LF-SB03-18.5-20.5	LF-SB04-0810	LF-SB05-12.5-14.5	-	-
DEPTH (feet):	8 - 10	0 - 2	18.5 - 20.5	8 - 10	12.5 - 14.5	-	-
LOCATION:	2LTB31	2LTB9	LF-SB03	LF-SB04	LF-SB05	-	-
SAMPLE DATE:	11/14/93	11/05/93	02/16/95	02/17/95	02/18/95	-	-
INVESTIGATION:	FFS	FFS	LFGE0	LFGE0	LFGE0	-	-
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	-	-
STATUS:						-	-
VOLATILES (UG/KG)							
1,1,2,2-TETRACHLOROETHANE	13 U	10 U	16 U	11 U	13 U		
1,1,2-TRICHLOROETHANE	13 U	10 U	16 U	11 U	13 U		
2-BUTANONE	13 U	10 U	16 U	11 U	13 U		
4-METHYL-2-PENTANONE	13 U	10 U	16 U	11 U	13 U		
ACETONE	63 U	19 UJ	18 J	11 U	13 U		
CARBON DISULFIDE	13 U	10 U	8 J	11 U	13 U		
CHLOROBENZENE	13 U	10 U	16 U	11 U	13 U		
ETHYLBENZENE	13 U	10 U	16 U	11 U	13 U		
METHYLENE CHLORIDE	16 U	10 U	8 J	2 J	2 J		
TETRACHLOROETHENE	13 U	10 U	16 U	11 U	13 U		
TOLUENE	19	8 J	16 U	11 U	13 U		
TRICHLOROETHENE	13 U	10 U	16 U	11 U	13 U		
XYLENES, TOTAL	13 U	10 U	16 U	11 U	13 U		
SEMIVOLATILES (UG/KG)							
2,4-DIMETHYLPHENOL	420 U	350 U	540 UJ	370 U	420 UJ		
2-METHYLNAPHTHALENE	420 U	350 U	540 UJ	370 U	420 UJ		
4-METHYLPHENOL	420 U	350 U	540 UJ	370 U	420 UJ		
ACENAPHTHENE	420 U	350 U	540 U	370 U	420 UJ		
ACENAPHTHYLENE	420 U	350 U	540 U	370 U	420 UJ		
ANTHRACENE	420 U	350 U	540 U	370 U	420 UJ		
BENZO(A)ANTHRACENE	400 J	200 J	540 U	370 U	420 U		
BENZO(A)PYRENE	450 J	190 J	310 J	370 U	420 U		
BENZO(B)FLUORANTHENE	440 J	180 J	540 U	370 U	420 U		
BENZO(G,H,I)PERYLENE	420 UJ	350 U	540 U	370 U	420 U		
BENZO(K)FLUORANTHENE	480 J	210 J	540 U	370 U	420 U		
BIS(2-ETHYLHEXYL)PHTHALATE	420 UJ	350 U	540 U	370 U	420 U		
CARBAZOLE	420 U	350 U	540 U	370 U	420 UJ		
CHRYSENE	540 J	190 J	540 U	370 U	420 U		
DI-N-BUTYL PHTHALATE	420 U	350 U	540 U	370 U	420 UJ		
DIBENZOFURAN	420 U	350 U	540 U	370 U	420 UJ		

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB31 (8-10)	2LTB9 (0-2)	LF-SB03-18.5-20.5	LF-SB04-0810	LF-SB05-12.5-14.5	-	-
DEPTH (feet):	8 - 10	0 - 2	18.5 - 20.5	8 - 10	12.5 - 14.5	-	-
LOCATION:	2LTB31	2LTB9	LF-SB03	LF-SB04	LF-SB05	-	-
SAMPLE DATE:	11/14/93	11/05/93	02/16/95	02/17/95	02/18/95	-	-
INVESTIGATION:	FFS	FFS	LFGE0	LFGE0	LFGE0	-	-
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	-	-
STATUS:						-	-

SEMIVOLATILES (UG/KG)

FLUORANTHENE	570	300 J	540 U	370 U	420 UJ		
FLUORENE	420 U	350 U	540 U	370 U	420 UJ		
INDENO(1,2,3-CD)PYRENE	420 UJ	350 U	540 U	370 U	420 U		
NAPHTHALENE	420 U	350 U	540 UJ	370 U	420 UJ		
PHENANTHRENE	390 J	350 U	540 U	370 U	420 UJ		
PYRENE	890 J	310 J	30 J	370 U	420 U		

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	410 J	230 J	5.4 UJ	3.7 UJ	4.2 UJ		
4,4'-DDE	450	60	5.4 UJ	3.7 UJ	4.2 UJ		
4,4'-DDT	410 J	71 J	5.4 UJ	3.7 UJ	4.2 UJ		
ALDRIN	19 U	1.8 U	2.8 UJ	1.9 UJ	2.2 UJ		
ALPHA-CHLORDANE	19 U	25 J	2.8 UJ	1.9 UJ	2.2 UJ		
AROCLOR-1242	1700	35 U	54 UJ	37 UJ	42 UJ		
AROCLOR-1248	380 U	35 U	54 UJ	37 UJ	42 UJ		
AROCLOR-1254	2100	160 J	54 UJ	37 UJ	42 UJ		
AROCLOR-1260	380 U	35 U	54 UJ	37 UJ	42 UJ		
DIELDRIN	38 U	7.5	5.4 UJ	3.7 UJ	4.2 UJ		
ENDOSULFAN II	38 U	3.5 U	5.4 UJ	3.7 UJ	4.2 UJ		
ENDOSULFAN-I	19 U	1.8 U	2.8 UJ	1.9 UJ	2.2 UJ		
ENDRIN	38 U	1.6 J	5.4 UJ	3.7 UJ	4.2 UJ		
ENDRIN ALDEHYDE	63	3.5 U	5.4 UJ	3.7 UJ	4.2 UJ		
ENDRIN KETONE	38 U	3.5 U	5.4 UJ	3.7 UJ	4.2 UJ		
GAMMA-CHLORDANE	19 U	31	2.8 UJ	1.9 UJ	2.2 UJ		
HEPTACHLOR	19 U	1.8 U	2.8 UJ	1.9 UJ	2.2 UJ		
HEPTACHLOR EPOXIDE	19 U	1.8 U	2.8 UJ	1.9 UJ	2.2 UJ		
METHOXYCHLOR	190 U	18 U	28 UJ	19 UJ	22 UJ		

INORGANICS (MG/KG)

ALUMINUM	9280	5600	15200	9780	18400		
ANTIMONY	25.6 J	1.3 UJ	1.3 U	0.87 U	1.0 U		
ARSENIC	8.6 J	0.87 UJ	9.0	0.94 J	4.5		

TABLE 6-4
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2LTB31 (8-10)	2LTB9 (0-2)	LF-SB03-18.5-20.5	LF-SB04-0810	LF-SB05-12.5-14.5	-	-
DEPTH (feet):	8 - 10	0 - 2	18.5 - 20.5	8 - 10	12.5 - 14.5	-	-
LOCATION:	2LTB31	2LTB9	LF-SB03	LF-SB04	LF-SB05	-	-
SAMPLE DATE:	11/14/93	11/05/93	02/16/95	02/17/95	02/18/95	-	-
INVESTIGATION:	FFS	FFS	LFGEO	LFGEO	LFGEO	-	-
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	-	-
STATUS:						-	-
INORGANICS (MG/KG)							
BARIUM	193 J	29.5 J	43.3	114	51.2		
BERYLLIUM	0.48	0.29	0.77	0.29 J	0.7		
BORON	22.7	0.95 U					
CADMIUM	5.3 J	0.48 J	0.32 J	0.22 U	0.26 U		
CALCIUM	6930	876	8530	1660	1070		
CHROMIUM	127 J	8.3 J	36.1	17.8	23.3		
COBALT	54.4	3.8	10.2	8.7	9.5		
COPPER	819 J	23.0 J	13.5	13.1	13.8		
CYANIDE	0.53	0.12 U	0.8 U	0.54 U	0.65 U		
IRON	146000	8860	25600	15200	17800		
LEAD	1290	13.7	8.6	8.1	9.6		
MAGNESIUM	3320	1680	8060	4750	3790		
MANGANESE	1040 J	93.9 J	326	298	248		
MERCURY	0.65	0.05 U	0.16 U	0.11 U	0.13 U		
NICKEL	245 J	13.6 J	20.9	9.5	11.2		
POTASSIUM	1750	1070	4500	3700	1150		
SELENIUM	0.16 UJ	0.13 J	2.3	0.81	1.4		
SILVER	4.8	0.15 U	0.64 U	0.44 U	0.52 U		
SODIUM	500 J	140 U	7190	99.9	93.7		
THALLIUM	0.92 UJ	0.16 U	1.8	0.87 U	1.0 U		
VANADIUM	22.6 J	13.8	40.3	29.1	38.2		
ZINC	7570 J	36.4 J	57.3	47.7	38.3		

TABLE 6-5
SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LMW13(2-4)	2LMW33(2-4)	2LMW13(6-8)	2LMW14S(5-7)	2LMW17(0-2)	2LMW17(4-8)	2LMW18S(0-2)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	08/22/90	08/22/90	08/22/90	08/02/90	08/15/90	08/15/90	08/07/90
LOCATION:	2LMW13S	2LMW13S	2LMW13S	2LMW14S	2LMW17S	2LMW17S	2LMW18S
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.200	0.170	0.190	0.0040	0.180 J	0.190 J	0.190 J
BARIUM (100.0/10.0)	0.230	0.200	0.220	0.160 J	0.350 J	0.340 J	0.250
CADMIUM (1.0/0.05)	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0089 J	0.0650 J	0.0050 U
CHROMIUM (5.0/0.5)	0.0500 U	0.0500 U	0.0500 U	0.0100 U	0.0100 J	0.0140 J	0.0100 U
LEAD (5.0/0.15)	0.100 U	0.100 U	0.100 U	0.0040 J	0.100 U	0.100 U	0.220 J
SELENIUM (1.0/0.5)	0.110 J	0.100 J	0.120 J	0.0030	0.100 U	0.100 U	0.100 U
SILVER (5.0/0.36)	0.0310 UJ	0.0080 UJ	0.0080 UJ	0.0100 J	0.0080 U	0.0080 U	0.0080 UJ

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 6-5**SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LMW18S(2-6)	2LMW7(7-10)	2LMW8S(6-10)	2LMW9(2-8)	2LMW9(0-4)	2LMW19(0-4)	2LSS1
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	08/07/90	08/15/90	08/02/90	08/16/90	08/17/90	08/17/90	11/28/90
LOCATION:	2LMW18S	2LMW7S	2LMW8S	2LMW9S	2LMW9S	2LMW9S	2LSS1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.100 U	0.210 J	0.0080	0.300 J	0.100 U	0.180 J	0.300 U
BARIUM (100.0/10.0)	0.300	0.300 J	0.140 J	0.320 J	0.290 J	0.290 J	0.370 J
CADMIUM (1.0/0.05)	0.0180	0.0050 J	0.0050 U	0.0340 J	0.0190 J	0.0220 J	0.0370
CHROMIUM (5.0/0.5)	0.0100 U	0.0100 U	0.0120 J	0.0350 J	0.0100 U	0.0100 U	0.0500 U
LEAD (5.0/0.15)	0.300 J	0.100 U	0.0070 J	0.840 J	0.170 J	0.250 J	0.300 U
SELENIUM (1.0/0.5)	0.100 U	0.100 J	0.0020 U	0.230 J	0.100 U	0.100 U	0.0060 J
SILVER (5.0/0.36)	0.0080 UJ	0.0080 U	0.0100 J	0.0420 J	0.0080 U	0.0080 U	0.0070 UR

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 6-5**SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LSS2	2LTB18 (0-2)	2LTB2(2-8)	2LTB26 (4-6)			
INVESTIGATION:	PH1	FFS	PH1	FFS			
SAMPLE DATE:	11/28/90	11/02/93	08/16/90	11/12/93			
LOCATION:	2LSS2	2LTB18	2LTB2	2LTB26			
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB			
STATUS:							
TCLP METALS (MGL)*							
ARSENIC (5.0/0.5)	0.300 U	0.0345 UJ	0.260 J	0.0345 U			
BARIUM (100.0/10.0)	0.280 J	1.06 J	0.340 J	0.532			
CADMIUM (1.0/0.05)	0.0150	0.0580 J	0.0310 J	0.0097			
CHROMIUM (5.0/0.5)	0.0500 U	0.0321 J	0.0290 J	0.0059			
LEAD (5.0/0.15)	0.300 U	2.19 J	0.560 J	0.301			
SELENIUM (1.0/0.5)	0.0020 U	0.0218 UJ	0.140 J	0.0218 U			
SILVER (5.0/0.36)	0.0070 UR	0.0019 UJ	0.0110 J	0.0019 U			

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 6-6
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 5

Analyte	SURFACE SOIL (<2 FEET) (1)			SUBSURFACE (> 2 FEET) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
1,1,2,2-Tetrachloroethane	0/15	-	ND (3)	1/20	22	2LMW14S
1,1,2-Trichloroethane	0/15	-	ND	1/20	11	2LMW14S
2-Butanone	1/15	2	2LSS2	0/20	-	ND
4-Methyl-2-pentanone	0/15	-	ND	1/20	12	2LMW18S
Acetone	4/15	12-15	2LSS23	5/20	18-250	2LTB2
Carbon disulfide	0/15	-	ND	2/20	5-8	LF-SB03
Chlorobenzene	2/15	43-4500	2LSS1	1/20	4500	2LTB23
Ethylbenzene	3/15	2-14000	2LSS1	5/20	15-28000	2LTB23
Methylene chloride	6/15	3-6	2LSS20	6/20	1-25	2LTB19
Tetrachloroethene	1/15	4	2LSS2	0/20	-	ND
Toluene	4/15	4-16	2LTB16	8/20	6-3200	2LTB23
Trichloroethene	1/15	2	2LSS2	1/20	2	2LMW14S
Xylenes, total	4/15	4-75000	2LSS1	6/20	7-140000	2LTB23
SEMIVOLATILE ORGANICS (ug/kg)						
2,4-Dimethylphenol	0/15	-	ND	1/20	190	2LTB23
2-Methylnaphthalene	0/15	-	ND	5/20	53-1300	2LTB2
4-Methylphenol	0/15	-	ND	2/20	340-2000	2LTB23
Acenaphthene	0/15	-	ND	4/20	50-8400	2LTB20
Acenaphthylene	0/15	-	ND	1/20	220	2LTB28
Anthracene	0/15	-	ND	5/20	230-19000	2LTB20
Benzo(a)anthracene	5/15	97-570	2LMW9	11/20	99-23000	2LTB20
Benzo(a)pyrene	4/15	46-430	2LMW9	10/20	250-15000	2LTB20
Benzo(b)fluoranthene	5/15	130-370	2LMW9	11/20	70-15000	2LTB20
Benzo(g,h,i)perylene	1/15	44	2LMW17	4/20	230-590	2LTB26
Benzo(k)fluoranthene	6/15	57-640	2LMW9	11/20	120-14000	2LTB20

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TABLE 6-6
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
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Analyte	SURFACE SOIL (< 2 FEET) (1)			SUBSURFACE (> 2 FEET) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Bis(2-ethylhexyl)phthalate	1/15	390	2LMW18S	5/20	78-1900	2LMW9
Carbazole	0/10	-	ND	3/11	410-9800	2LTB20
Chrysene	6/15	37-460	2LMW9	11/20	100-19000	2LTB20
Di-n-butyl phthalate	1/15	61	2LMW17	1/20	76	2LMW7
Dibenzofuran	0/15	-	ND	4/20	83-13000	2LTB20
Fluoranthene	7/15	49-750	2LMW9	12/20	170-47000	2LTB20
Fluorene	0/15	-	ND	4/20	130-17000	2LTB20
Indeno(1,2,3-cd)pyrene	0/15	-	ND	4/20	230-640	2LTB26
Naphthalene	0/15	-	ND	6/20	120-20000	2LTB20
Phenanthrene	4/15	66-410	2LMW9	13/20	140-61000	2LTB20
Pyrene	8/15	57-1100	2LSS2	13/20	30-40000	2LTB20
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	4/15	79-230	2LTB9	10/20	9.6-2200	2LTB29
4,4'-DDE	5/15	20-67	2LTB18	8/20	4.2-450	2LTB31
4,4'-DDT	7/15	6.8-2300	2LSS2	7/20	13-1300	2LTB29
Aldrin	1/15	0.56	2LTB16	0/20	-	ND
Alpha-Chlordane	4/15	12-39	2LTB16	3/20	2-100	2LTB29
Aroclor-1242	0/15	-	ND	1/20	1700	2LTB31
Aroclor-1254	7/15	15-490	2LTB18	8/20	49-100000	2LTB23
Aroclor-1260	3/15	230-12000	2LSS2	1/20	2500	2LTB28
Dieldrin	3/15	4.4-7.5	2LTB9	2/20	1.2-35	2LTB29
Endosulfan II	1/15	2	2LTB17	0/20	-	ND
Endosulfan-I	0/15	-	ND	3/20	2-340	2LTB23
Endrin	3/15	0.89-2.4	2LTB16	4/20	3.7-470	2LTB23
Endrin aldehyde	1/10	19	2LTB17	3/11	40-91	2LTB20
Endrin ketone	1/15	570	2LSS2	1/20	5.9	2LTB20
Gamma-Chlordane	4/15	11-61	2LTB16	2/20	3-95	2LTB29
Heptachlor	0/15	-	ND	3/20	0.51-79	2LTB23

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TABLE 6-6
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
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Analyte	SURFACE SOIL (< 2 FEET) (1)			SUBSURFACE (> 2 FEET) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Heptachlor epoxide	0/15	-	ND	2/20	0.66-5.3	2LTB29
Methoxychlor	1/15	19	2LTB17	0/20	-	ND
PESTICIDES/PCBs - FIELD SCREENING (ug/kg)						
Aroclor-1248	2/3	94-780	2LTB13	6/7	51-3700	2LTB23
Aroclor-1254	2/3	200-340	2LTB23	5/7	110-19400	2LTB23
DIOXINS/FURANS (ug/kg)						
1,2,3,4,6,7,8-HpCDF	0/2	-	ND	1/2	0.246	2LTB23
1,2,3,4,7,8-HxCDF	0/2	-	ND	1/2	0.306	2LTB23
1,2,3,6,7,8-HxCDF	0/2	-	ND	1/2	0.153	2LTB23
OCDD	2/2	1.592-2.5	2LTB13	2/2	1.626-1.7	2LTB23
INORGANICS (mg/kg)						
Aluminum	15/15	5150-12200	2LSS21	20/20	4450-15100	2LMW13
Antimony	0/13	-	ND	6/18	25.6-134	2LTB22
Arsenic	12/15	0.59-3.7	2LMW18S	20/20	0.94-10.6	2LTB22
Barium	15/15	29.5-199	2LTB17	20/20	18.4-667	2LTB23
Beryllium	15/15	0.29-3	2LMW9	20/20	0.25-3.9	2LMW18S
Boron	0/10	-	ND	5/8	22.7-79.8	2LTB22
Cadmium	10/15	0.48-6	2LMW9	18/20	0.32-12.1	2LTB23
Calcium	15/15	794-6090	2LSS23	20/20	856-17200	2LTB22
Chromium	15/15	8.2-26.5	2LTB17	20/20	8.8-289	2LTB22
Cobalt	15/15	3.8-23.8	2LMW9	19/20	4.3-122	2LTB22
Copper	15/15	4.3-871	2LTB18	20/20	12.4-21600	2LTB22
Cyanide	4/15	0.08-0.22	2LTB17	3/20	0.35-0.74	2LTB29
Iron	15/15	7660-17700	2LMW9	20/20	8260-157000	2LTB22
Lead	15/15	5-449	2LTB17	20/20	5.5-1780	2LTB22
Magnesium	15/15	1680-3960	2LSS20	20/20	1570-9330	2LTB23
Manganese	15/15	93.9-285	2LTB18	20/20	74-1150	2LTB22
Mercury	3/15	0.03-0.61	2LTB18	9/20	0.14-3.6	2LMW17

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TABLE 6-6
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
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Analyte	SURFACE SOIL (<2 FEET) (1)			SUBSURFACE (> 2 FEET) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Nickel	15/15	5.6-76.2	2LMW9	20/20	9.6-1440	2LTB22
Potassium	15/15	935-3110	2LSS20	20/20	549-4500	LF-SB03
Selenium	3/15	0.13-0.47	2LSS1	4/20	0.77-2.3	LF-SB03
Silver	0/15	-	ND	7/18	2.8-38.9	2LTB19
Sodium	14/15	34.3-2030	2LTB17	19/20	93.7-7190	LF-SB03
Thallium	0/15	-	ND	1/20	1.8	LF-SB03
Vanadium	15/15	13.8-36.2	2LMW18S	20/20	13.9-138	2LTB20
Zinc	15/15	24.5-5340	2LTB18	20/20	27.5-9850	2LTB22

TCLP METALS (mg/L)

Arsenic (5.0/0.5) (4)	3/6	0.18-0.19	2LMW18S	8/10	0.004-0.3	2LMW9
Barium (100.0/10)	6/6	0.25-1.06	2LTB18	10/10	0.14-0.532	2LTB26
Cadmium (1.0/0.05)	5/6	0.0089-0.058	2LTB18	6/10	0.005-0.065	2LMW17
Chromium (5.0/0.5)	2/6	0.01-0.0321	2LTB18	5/10	0.0059-0.035	2LMW9
Lead (5.0/0.15)	3/6	0.22-2.19	2LTB18	6/10	0.004-0.84	2LMW9
Selenium (1.0/0.5)	1/6	0.006	2LSS1	6/10	0.003-0.23	2LMW9
Silver (5.0/0.36)	0/4	-	ND	4/10	0.01-0.042	2LMW9

MISCELLANEOUS PARAMETERS

Ash (%)	1/1	92	2LTB17	1/1	93.5	2LTB19
Cation exchange capacity (meq/100g)	1/1	4.9	2LTB17	1/1	3.9	2LTB19
pH	1/1	8.08	2LTB17	1/1	8.56	2LTB19

TABLE 6-6
SUMMARY OF SOIL ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 5 OF 5

Analyte	SURFACE SOIL (<2 FEET) (1)			SUBSURFACE (> 2 FEET) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Specific gravity (g/cm ³)	1/1	2.4	2LTB17	1/1	2.3	2LTB19
Total organic carbon (mg/kg)	1/1	4500	2LTB17	1/1	2900	2LTB19

- 1 Includes samples 2LMW17 (0-2), 2LMW18S (0-2), 2LMW9 (0-4), 2LMW19 (0-4) (field duplicate of 2LMW9 (0-4)), 2LSS1, 2LSS2, 2LSS20 (0-1), 2LSS30 (0-1) (field duplicate of 2LSS20 (0-1)), 2LSS21 (0-1), 2LSS22 (0-1), 2LSS23 (0-1), 2LSS24 (0-1), 2LTB13 (0-2), 2LTB13-0001, 2LTB13-0001A, 2LTB13-0102, 2LTB16 (0-2), 2LTB17 (0-2), 2LTB18 (0-2), 2LTB23-0002, and 2LTB9 (0-2). Maximum concentrations are used for evaluation of field duplicates and are counted as one sample.
- 2 Includes samples 2LMW13 (2-4), 2LMW33 (2-4) (field duplicate of 2LMW13), 2LMW13 (6-8), 2LMW14S (5-7), 2LMW17 (4-8), 2LMW18S (2-6), 2LMW7 (7-10), 2LMW8S (6-10), 2LMW9 (2-8), 2LTB13-0204, 2LTB13-0406, 2LTB13-0608, 2LTB19 (2-4), 2LTB19 (4-6), 2LTB2 (2-8), 2LTB20 (6-8), 2LTB22 (6-8), 2LTB22 (8-10), 2LTB23 (4-8), 2LTB33 (4-8) (field duplicate of 2LTB23 (4-8)), 2LTB23-0406, 2LTB23-0608, 2LTB23-0810, 2LTB23-1012, 2LTB26 (4-6), 2LTB28 (4-6), 2LTB29 (10-12), 2LTB39 (10-12) (field duplicate of 2LTB29 (10-12)), 2LTB31 (8-10), LF-SB03 - 18.5-20.5, LF-SB04-0810, and LF-SB05 - 12.5-14.5. Maximum concentrations are used for evaluation of field duplicates and are counted as one sample.
- 3 Not Detected.
- 4 Values in parentheses represent Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Clean-Up Standard Pollutant Mobility Criteria for GB Waters.

TABLE 6-7**SUMMARY OF POSITIVE PAVEMENT ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LC1	2LC2	2LC3	2LC4			
LOCATION:	2LC1	2LC2	2LC3	2LC4			
SAMPLE DATE:	11/15/93	11/15/93	11/15/93	11/15/93	//	//	//
INVESTIGATION:	FFS	FFS	FFS	FFS			
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB			
PESTICIDES/PCBs (UG/KG)							
4,4-DDD	3.3 UJ	30 UJ	170 U	12			
4,4-DDE	3.3 U	30 UJ	170 U	5			
4,4-DDT	3.3 J	30 UJ	550	4.3			
ALPHA-BHC	1.7 U	15 UJ	21 J	1.7 U			
AROCLOR-1260	33 UJ	490 J	1700 U	340			
DIELDRIN	3.3 U	30 UJ	160 J	3.3 U			
ENDOSULFAN II	3.3 UJ	30 UJ	440 J	3.3 U			
ENDOSULFAN-I	1.7 U	15 UJ	78 J	1.7 U			
ENDRIN	0.79 J	30 UJ	15 J	3.5			
ENDRIN ALDEHYDE	9.4 J	30 UJ	170 U	3.3 U			
ENDRIN KETONE	3.3 UJ	30 UJ	130 J	3.6			
GAMMA-CHLORDANE	1.7 U	15 UJ	86 U	1.1 J			
HEPTACHLOR EPOXIDE	0.51 J	4.2 J	300 J	2.2			

TABLE 6-8

SUMMARY OF PAVEMENT ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Analyte	PAVEMENT SAMPLES (1)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection
PESTICIDES/PCBs			
Aroclor-1260	2/4	340-490	2LC2
4,4'-DDD	1/4	12	2LC4
4,4'-DDE	1/4	5	2LC4
4,4'-DDT	3/4	3.3-550	2LC3
Alpha-BHC	1/4	21	2LC3
Dieldrin	1/4	160	2LC3
Endosulfan II	1/4	440	2LC3
Endosulfan I	1/4	78	2LC3
Endrin	3/4	0.79-15	2LC3
Endrin aldehyde	1/4	9.4	2LC1
Endrin ketone	2/4	3.6-130	2LC3
Gamma-Chlordane	1/4	1.1	2LC4
Heptachlor epoxide	4/4	0.51-300	2LC3

1 Includes samples 2LC1, 2LC2, 2LC3, and 2LC4.

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	011091-2LMW13D	2LGW13D	2LGW13D	2LGW13D-2	2LGW13D-2	2LGW13S	2LGW13S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1
SAMPLE DATE:	01/10/91	03/21/94	03/21/94	07/08/94	07/08/94	01/25/94	01/25/94
LOCATION:	2LMW13D	2LMW13D	2LMW13D	2LMW13D	2LMW13D	2LMW13S	2LMW13S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	140	52		62		10 U	
1,2-DICHLOROETHENE (TOTAL)	1 J	2 J		1 J		2 J	
4-METHYL-2-PENTANONE	10 U	10 U		10 U		10 U	
ACETONE	10 U	11 U		10 U		10 U	
BENZENE	5 U	10 U		10 U		10 U	
CARBON DISULFIDE	5 U	10 U		10 U		1 J	
CHLOROBENZENE	5 U	10 U		10 U		10 U	
CHLOROFORM	5 U	10 U		10 U		10 U	
ETHYLBENZENE	5 U	10 U		10 U		10 U	
METHYLENE CHLORIDE	5 U	10 U		1 J		10 U	
TETRACHLOROETHENE	5 U	10 U		3 J		10 U	
TOLUENE	5 U	10 U		10 U		10 U	
TRICHLOROETHENE	10	4 J		23		10 U	
XYLENES, TOTAL	5 U	10 U		10 U		10 U	

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U	10 U		10 U		10 U	
1,2-DICHLOROBENZENE	10 U	10 U		10 U		10 U	
1,3-DICHLOROBENZENE	10 U	10 U		10 U		10 U	
1,4-DICHLOROBENZENE	10 U	10 U		10 U		10 U	
2,4-DICHLOROPHENOL	10 U	10 U		10 U		10 U	
2,4-DIMETHYLPHENOL	10 U	10 U		10 U		10 U	
2,4-DINITROTOLUENE	10 U	10 U		10 U		10 U	
2-CHLOROPHENOL	10 U	10 U		10 U		10 U	
2-METHYLNAPHTHALENE	10 U	10 U		10 U		10 U	
4-CHLORO-3-METHYLPHENOL	10 U	10 U		10 U		10 U	
4-METHYLPHENOL	10 U	10 U		10 U		10 U	
ACENAPHTHENE	10 U	10 U		10 U		10 U	
ANTHRACENE	10 U	10 U		10 U		10 U	
BENZOIC ACID	50 U	50 UJ		2 J		1 J	
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U		10 U		20	
BUTYL BENZYL PHTHALATE	10 U	10 U		10 U		10 U	

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	011091-2LMW13D	2LGW13D	2LGW13D	2LGW13D-2	2LGW13D-2	2LGW13S	2LGW13S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1
SAMPLE DATE:	01/10/91	03/21/94	03/21/94	07/08/94	07/08/94	01/25/94	01/25/94
LOCATION:	2LMW13D	2LMW13D	2LMW13D	2LMW13D	2LMW13D	2LMW13S	2LMW13S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

SEMIVOLATILES (UG/L)

CARBAZOLE		10 U		10 U		10 UJ	
DI-N-BUTYL PHTHALATE	10 U	10 U		10 U		10 U	
DI-N-OCTYL PHTHALATE	10 U	10 U		10 U		10 U	
DIBENZOFURAN	10 U	10 U		10 U		10 U	
DIETHYL PHTHALATE	10 U	10 U		10 U		10 U	
FLUORENE	10 U	10 U		10 U		10 U	
N-NITROSODIPHENYLAMINE	10 U	10 U		10 U		10 U	
NAPHTHALENE	10 U	10 U		10 U		10 U	
PHENANTHRENE	10 U	10 U		10 U		10 U	
PHENOL	10 U	10 U		10 U		10 U	

PESTICIDES/PCBs (UG/L)

AROCOR-1016	0.5 U						
AROCOR-1254	1 U						
AROCOR-1260	1 U						

INORGANICS (UG/L)

ALUMINUM	30.0 U	255	24.3 U	240 U	61.9 U	89300	35.8 U
ANTIMONY	25.0 U	15.0 U	15.0 UJ	17.9 U	12.0 U	77.4 R	34.1
ARSENIC	3.0 U	2.0 U	2.0 UJ	3.6 U	5.0 U	19.6 J	7.3 J
BARIUM	33.4	63.0	61.5	87.9	87.5	418	37.4
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.2	1.0 U
BORON	5.4 R	50.0 U	50.0 U	40.9 U	28.0	123 U	131 U
CADMIUM	44.8 J	2.0 U	2.0 U	2.7 J	2.0 U	2.0 U	2.0 U
CALCIUM	36100	50000	49900	61300	65100	41700	28300
CHROMIUM	5.0 U	3.0 UJ	3.0 U	3.0 U	3.5 U	142	3.0 U
COBALT	5.0 U	9.0 U	4.0 U	3.0 U	3.0 U	35.5	4.0 U
COPPER	5.0 U	2.0 U	2.0 U	6.6	4.7 U	125	4.2
IRON	3760 J	10800	4350	14100	3100	117000	43900
LEAD	2.0 UJ	2.0 U	2.0 UJ	3.6 J	2.0 U	51.1	1.0 UJ
MAGNESIUM	4510	6620	6570	8120	8470	31400	5910
MANGANESE	408	186	178	281	277	2570	1810
MERCURY	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U	0.32	0.2 U

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TABLE 6-9**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	011091-2LMW13D	2LGW13D	2LGW13D	2LGW13D-2	2LGW13D-2	2LGW13S	2LGW13S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1
SAMPLE DATE:	01/10/91	03/21/94	03/21/94	07/08/94	07/08/94	01/25/94	01/25/94
LOCATION:	2LMW13D	2LMW13D	2LMW13D	2LMW13D	2LMW13D	2LMW13S	2LMW13S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
INORGANICS (UG/L)							
NICKEL	21.7 J	18.4 U	10.0 U	8.4 U	7.0 U	79.5	10.0 U
POTASSIUM	1950	3100	3240	4390	4200	10700	2800
SELENIUM	1.0 U	3.0 U	3.0 UJ	3.0 U	5.0 UJ	30.0 U	3.0 UJ
SILVER	7.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U
SODIUM	26500	45600	45600	60100	63300	39600	39900
THALLIUM	2.0 U	10.0 UR	10.0 UR	4.0 J	5.0 U	10.0 UJ	1.0 UJ
VANADIUM	20.0 U	5.0 U	5.0 U	3.8 U	3.0 U	182	5.0 U
ZINC	10.8 J	8.2 U	2.0 U	12.3 U	12.6 U	211	5.3 U
RADIONUCLIDES (PCI/L)							
GAMMA SPEC (K40)		ND		ND			
GROSS ALPHA	17.9 +/- 4.20	12 +/- 3.00 J		24 +/- 5.00 U			
GROSS BETA	24.1 +/- 3.90	19 +/- 3.00 J		42 +/- 4.00			
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3		156		182		600	

TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	121790-2LMW14D	2LGW14D	2LGW14D	010891-2LMW17D	2LGW17D	2LGW17D	2LGW17D-2
INVESTIGATION:	PH1	PH2-1	PH2-1	PH1	PH2-1	PH2-1	PH2-2
SAMPLE DATE:	12/17/90	03/21/94	03/21/94	01/08/91	03/15/94	03/15/94	07/10/94
LOCATION:	2LMW14D	2LMW14D	2LMW14D	2LMW17D	2LMW17D	2LMW17D	2LMW17D
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	5 U	10 U		1 J	10 U		10 U
1,2-DICHLOROETHENE (TOTAL)	5 U	10 U		5 U	10 U		10 U
4-METHYL-2-PENTANONE	10 U	10 U		10 U	10 U		49
ACETONE	10 U	10 U		10 U	10 U		23 U
BENZENE	5 U	10 U		5 U	10 U		10 U
CARBON DISULFIDE	5 U	1 J		5 U	10 U		1 J
CHLOROBENZENE	5 U	10 U		5 U	10 U		10 U
CHLOROFORM	5 U	10 U		5 U	10 U		10 U
ETHYLBENZENE	5 U	10 U		5 U	10 U		10 U
METHYLENE CHLORIDE	5 U	10 U		5 U	10 U		19 U
TETRACHLOROETHENE	5 U	10 U		5 U	10 U		10 U
TOLUENE	5 U	10 U		5 U	10 U		10 U
TRICHLOROETHENE	5 U	10 U		5 U	10 U		10 U
XYLENES, TOTAL	5 U	10 U		5 U	10 U		2 J

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U	10 U		10 U	10 U		20 U
1,2-DICHLOROBENZENE	10 U	10 U		10 U	10 U		20 U
1,3-DICHLOROBENZENE	10 U	10 U		10 U	10 U		20 U
1,4-DICHLOROBENZENE	10 U	10 U		10 U	10 U		20 U
2,4-DICHLOROPHENOL	10 U	10 U		10 U	10 U		20 U
2,4-DIMETHYLPHENOL	10 U	10 U		10 U	10 U		20 U
2,4-DINITROTOLUENE	10 U	10 U		10 U	10 U		20 U
2-CHLOROPHENOL	10 U	10 U		10 U	10 U		20 U
2-METHYLNAPHTHALENE	10 U	10 U		10 U	10 U		20 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U		10 U	10 U		20 U
4-METHYLPHENOL	10 U	10 U		10 U	10 U		6 J
ACENAPHTHENE	10 U	10 U		10 U	10 U		20 U
ANTHRACENE	10 U	10 U		10 U	10 U		20 U
BENZOIC ACID	50 U	50 U		50 U	50 U		50 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U		10 U	10 U		8 J
BUTYL BENZYL PHTHALATE	10 U	10 U		10 U	10 U		20 U

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	121790-2LMW14D	2LGW14D	2LGW14D	010891-2LMW17D	2LGW17D	2LGW17D	2LGW17D-2
INVESTIGATION:	PH1	PH2-1	PH2-1	PH1	PH2-1	PH2-1	PH2-2
SAMPLE DATE:	12/17/90	03/21/94	03/21/94	01/08/91	03/15/94	03/15/94	07/10/94
LOCATION:	2LMW14D	2LMW14D	2LMW14D	2LMW17D	2LMW17D	2LMW17D	2LMW17D
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE		10 U			10 U		20 U
DI-N-BUTYL PHTHALATE	10 U	10 U		10 U	10 U		20 U
DI-N-OCTYL PHTHALATE	10 U	10 U		10 U	10 U		20 U
DIBENZOFURAN	10 U	10 U		10 U	10 U		20 U
DIETHYL PHTHALATE	10 U	10 U		10 U	0.6 J		120
FLUORENE	10 U	10 U		10 U	10 U		20 U
N-NITROSODIPHENYLAMINE	10 U	10 U		10 U	10 U		20 U
NAPHTHALENE	10 U	10 U		10 U	10 U		20 U
PHENANTHRENE	10 U	10 U		10 U	10 U		20 U
PHENOL	10 U	10 U		10 U	10 U		6 J

PESTICIDES/PCBs (UG/L)

AROCLOR-1016	0.51 U			0.51 U			
AROCLOR-1254	1 U			1 U			
AROCLOR-1260	1 U			1 U			

INORGANICS (UG/L)

ALUMINUM	35.8	186	135 U	30.0 U	787	119 U	449
ANTIMONY	25.0 U	15.0 U	15.4 U	25.0 U	15.0 U	15.0 UJ	12.0 U
ARSENIC	3.0 U	3.0	2.0 U	3.0 U	3.6 J	2.0 U	7.0 J
BARIUM	32.9	111	111	31.0	62.3	59.1	32.2
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	2.5 R	50.0 U	50.0 U	2.3 R	50.0 UJ	50.0 U	16.4 U
CADMIUM	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.1 U	2.0 UJ	2.2 J
CALCIUM	18200	37200	37300	18300	25200	25700	21600
CHROMIUM	5.0 U	3.0 U	5.3 U	5.0 U	3.0 U	3.0 UJ	3.0 U
COBALT	5.0 U	17.0 U	14.9 U	5.0 U	4.0 U	4.0 U	3.0 U
COPPER	15.1 J	10.2 U	2.7 U	5.0 U	5.0	2.0 U	5.2
IRON	28.1 J	5020	1090	13200	28000	1770	32600
LEAD	4.4 J	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 U	3.9 U
MAGNESIUM	2120	6340	6470	3210	5940	6090	4640
MANGANESE	595	1360	1350	286	510	493	189
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.36 J

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	121790-2LMW14D	2LW14D	2LW14D	010891-2LMW17D	2LW17D	2LW17D	2LW17D-2
INVESTIGATION:	PH1	PH2-1	PH2-1	PH1	PH2-1	PH2-1	PH2-2
SAMPLE DATE:	12/17/90	03/21/94	03/21/94	01/08/91	03/15/94	03/15/94	07/10/94
LOCATION:	2LMW14D	2LMW14D	2LMW14D	2LMW17D	2LMW17D	2LMW17D	2LMW17D
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered

INORGANICS (UG/L)

NICKEL	7.0 U	10.0 UJ	10.0 UJ	18.4 J	10.0 U	14.5 U	7.0 U
POTASSIUM	5830 J	2840	3200	9630	1930	1650	2030
SELENIUM	1.0 U	3.0 U	3.0 U	1.0 U	3.0 UJ	3.0 UJ	5.0 UJ
SILVER	7.0 U	2.0 UJ	2.0 UJ	7.0 U	2.0 UJ	2.3 U	2.0 U
SODIUM	26500	68600	68800	10600	16500	15900	16700
THALLIUM	2.0 U	10.0 UJ	10.0 U	2.0 U	10.0 UR	1.0 UR	5.0 U
VANADIUM	20.0 U	5.0 U	6.3	20.0 U	5.0 U	5.0 U	3.0 U
ZINC	18.6 J	28.6	19.4	8.7 J	3.7 U	8.9 U	17.1 U

RADIONUCLIDES (PCI/L)

GROSS ALPHA	1.5 +/- 2.20			2.9 +/- 2.20			
GROSS BETA	11.6 +/- 3.10			4 +/- 3.00			

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO ₃		122			92		160
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TABLE 6-9
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW17D-2	010291-2LMW17S	2LGW17S	2LGW17S	2LGW17S-2	2LGW17S-2	121390-2LMW18D
INVESTIGATION:	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	07/10/94	01/02/91	03/15/94	03/15/94	07/10/94	07/10/94	12/13/90
LOCATION:	2LMW17D	2LMW17S	2LMW17S	2LMW17S	2LMW17S	2LMW17S	2LMW18D
SCREEN DEPTH:	Deep	Shallow	Shallow	Shallow	Shallow	Shallow	Deep
FILTERING:	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE		5 U	10 U		10 U		5 U
1,2-DICHLOROETHENE (TOTAL)		5 U	10 U		10 U		5 U
4-METHYL-2-PENTANONE		10 U	10 U		10 U		10 U
ACETONE		10 U	10 U		12 U		10 U
BENZENE		5 U	10 U		10 U		5 U
CARBON DISULFIDE		5 U	10 U		10 U		5 U
CHLOROBENZENE		5 U	10 U		10 U		5 U
CHLOROFORM		5 U	10 U		10 U		5 U
ETHYLBENZENE		5 U	10 U		10 U		5 U
METHYLENE CHLORIDE		5 U	10 U		17 U		5 U
TETRACHLOROETHENE		5 U	10 U		10 U		5 U
TOLUENE		5 U	10 U		10 U		5 U
TRICHLOROETHENE		5 U	10 U		10 U		5 U
XYLENES, TOTAL		5 U	10 U		10 U		5 U

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE		10 U	10 U		10 U		10 U
1,2-DICHLOROBENZENE		10 U	10 U		10 U		10 U
1,3-DICHLOROBENZENE		10 U	10 U		10 U		10 U
1,4-DICHLOROBENZENE		10 U	10 U		10 U		10 U
2,4-DICHLOROPHENOL		10 U	10 U		10 U		10 U
2,4-DIMETHYLPHENOL		10 U	10 U		10 U		10 U
2,4-DINITROTOLUENE		10 U	10 U		10 U		10 U
2-CHLOROPHENOL		10 U	10 U		10 U		10 U
2-METHYLNAPHTHALENE		10 U	10 U		10 U		10 U
4-CHLORO-3-METHYLPHENOL		10 U	10 U		10 U		10 U
4-METHYLPHENOL		10 U	10 U		10 U		10 U
ACENAPHTHENE		10 U	10 U		10 U		10 U
ANTHRACENE		10 U	10 U		10 U		10 U
BENZOIC ACID		50 U	50 UJ		50 U		50 U
BIS(2-ETHYLHEXYL)PHTHALATE		10 U	10 U		10 U		6 J
BUTYL BENZYL PHTHALATE		10 U	10 U		10 U		10 U

TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW17D-2	010291-2LMW17S	2LGW17S	2LGW17S	2LGW17S-2	2LGW17S-2	121390-2LMW18D
INVESTIGATION:	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	07/10/94	01/02/91	03/15/94	03/15/94	07/10/94	07/10/94	12/13/90
LOCATION:	2LMW17D	2LMW17S	2LMW17S	2LMW17S	2LMW17S	2LMW17S	2LMW18D
SCREEN DEPTH:	Deep	Shallow	Shallow	Shallow	Shallow	Shallow	Deep
FILTERING:	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE			10 U		10 U		
DI-N-BUTYL PHTHALATE		10 U	10 U		10 U		10 U
DI-N-OCTYL PHTHALATE		10 U	10 U		10 U		10 U
DIBENZOFURAN		10 U	10 U		10 U		10 U
DIETHYL PHTHALATE		10 U	10 U		10 U		10 U
FLUORENE		10 U	10 U		10 U		10 U
N-NITROSODIPHENYLAMINE		10 U	10 U		10 U		10 U
NAPHTHALENE		10 U	10 U		10 U		10 U
PHENANTHRENE		10 U	10 U		10 U		10 U
PHENOL		10 U	10 U		10 U		10 U

PESTICIDES/PCBs (UG/L)

AROCLOR-1016		0.52 U					0.52 U
AROCLOR-1254		1 U					1 U
AROCLOR-1260		1 U					1 U

INORGANICS (UG/L)

ALUMINUM	31.8 U	54.3	67.9 U	96.4 U	93.8 U	84.8 U	30.0 U
ANTIMONY	12.0 U	25.0 U	15.0 U	15.0 UJ	12.0 U	12.0 U	25.0 U
ARSENIC	5.0 U	3.0 U	2.3 J	2.3 J	7.5 J	5.0 U	3.0 U
BARIUM	32.6	18.5	30.8	29.2	34.5	36.8	66.3
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	13.0 U	1.7 R	50.0 UJ	50.0 U	39.5 U	35.7 U	2.4 R
CADMIUM	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 U	7.2
CALCIUM	22600	14300	24300	25000	26900	28600	21000
CHROMIUM	3.0 UJ	5.0 U	3.0 U	3.0 UJ	3.0 U	3.2 U	5.0 U
COBALT	3.0 U	5.0 U	4.0 U	8.9 U	3.0 U	3.0 U	5.0 U
COPPER	2.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.4 J
IRON	2500 J	8620	8820	8990	11700	12700 J	36800
LEAD	2.0 U	7.1 J	2.0 UJ	2.0 U	2.0 UJ	6.3	2.0 U
MAGNESIUM	4870	2970	5290	5480	6140	6290	4340
MANGANESE	151	323	443	456	387	415	863
MERCURY	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW17D-2	010291-2LMW17S	2LGW17S	2LGW17S	2LGW17S-2	2LGW17S-2	121390-2LMW18D
INVESTIGATION:	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	07/10/94	01/02/91	03/15/94	03/15/94	07/10/94	07/10/94	12/13/90
LOCATION:	2LMW17D	2LMW17S	2LMW17S	2LMW17S	2LMW17S	2LMW17S	2LMW18D
SCREEN DEPTH:	Deep	Shallow	Shallow	Shallow	Shallow	Shallow	Deep
FILTERING:	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

INORGANICS (UG/L)

NICKEL	7.0 U	17.6 J	10.0 U	11.7 U	7.0 U	7.0 U	7.0 U
POTASSIUM	2450 U	1300	2250	2220	2990	2500 U	4350 J
SELENIUM	5.0 UJ	1.0 U	3.0 UJ	3.0 UJ	5.0 UJ	5.0 UJ	1.0 U
SILVER	2.0 U	7.0 U	2.0 UJ	2.6 U	2.0 U	2.0 U	7.0 U
SODIUM	17200	10700	17100	17200	21800	20900	27400
THALLIUM	5.0 U	2.0 UR	10.0 UR	1.0 UR	5.0 U	5.0 U	2.0 U
VANADIUM	1.0 U	20.0 U	5.0 U	5.0 U	3.0 U	1.0 U	20.0 U
ZINC	4.5 U	15.9 J	2.0 U	4.0 U	7.2 U	9.6 U	12.0 J

RADIONUCLIDES (PCI/L)

GROSS ALPHA		3.3 +/- 1.90					0 +/- 2.10
GROSS BETA		1.8 +/- 3.00					3.7 +/- 3.00

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO3			86		90		
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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW18D	2LGW18D	2LGW18D-2	2LGW18D-2	121390-2LMW18S	121390-2LMW19S	2LGW18S
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH1	PH2-1
SAMPLE DATE:	03/23/94	03/23/94	06/26/94	06/26/94	12/13/90	12/13/90	03/23/94
LOCATION:	2LMW18D	2LMW18D	2LMW18D	2LMW18D	2LMW18S	2LMW18S	2LMW18S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Unfiltered
VOLATILES (UG/L)							
1,1,2,2-TETRACHLOROETHANE	10 U		10 U		25 U	25 U	20 U
1,2-DICHLOROETHENE (TOTAL)	10 U		10 U		25 U	25 U	20 U
4-METHYL-2-PENTANONE	10 U		10 U		50 U	50 U	20 U
ACETONE	12 U		10 U		50 U	50 U	49 U
BENZENE	10 U		10 U		10 J	9 J	6 J
CARBON DISULFIDE	10 U		10 U		25 U	25 U	20 U
CHLOROBENZENE	10 U		6 J		220	140	340
CHLOROFORM	10 U		10 U		25 U	25 U	20 U
ETHYLBENZENE	10 U		10 U		120	110	38
METHYLENE CHLORIDE	10 U		45 U		25 U	25 U	20 U
TETRACHLOROETHENE	10 U		10 U		25 U	25 U	20 U
TOLUENE	10 U		10 U		25 U	25 U	2 J
TRICHLOROETHENE	10 U		10 U		25 U	25 U	20 U
XYLENES, TOTAL	10 U		10 U		840	620	760
SEMIVOLATILES (UG/L)							
1,2,4-TRICHLOROBENZENE	10 U		10 UJ		67 J	72 J	7 J
1,2-DICHLOROBENZENE	10 U		10 UJ		10 J	14 J	10 U
1,3-DICHLOROBENZENE	10 U		10 UJ		25 J	33 J	7 J
1,4-DICHLOROBENZENE	10 U		10 UJ		99 J	140 J	14
2,4-DICHLOROPHENOL	10 U		10 UJ		10 UJ	10 UJ	10 U
2,4-DIMETHYLPHENOL	10 U		10 UJ		19 J	10 UJ	10 U
2,4-DINITROTOLUENE	10 U		10 UJ		10 UJ	10 UJ	10 U
2-CHLOROPHENOL	10 U		10 UJ		4 J	10 UJ	10 U
2-METHYLNAPHTHALENE	10 U		10 UJ		3 J	4 J	6 J
4-CHLORO-3-METHYLPHENOL	10 U		10 UJ		10 UJ	10 UJ	10 U
4-METHYLPHENOL	10 U		10 UJ		15 J	22 J	6 J
ACENAPHTHENE	10 U		10 UJ		10 UJ	10 UJ	1 J
ANTHRACENE	10 U		10 UJ		10 UJ	10 UJ	10 U
BENZOIC ACID	2 J		50 U		50 UJ	50 UJ	14 J
BIS(2-ETHYLHEXYL)PHTHALATE	10 U		10 U		4 J	10 UJ	10 U
BUTYL BENZYL PHTHALATE	10 U		10 UJ		10 UJ	10 UJ	10 U

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW18D	2LGW18D	2LGW18D-2	2LGW18D-2	121390-2LMW18S	121390-2LMW19S	2LGW18S
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH1	PH2-1
SAMPLE DATE:	03/23/94	03/23/94	06/26/94	06/26/94	12/13/90	12/13/90	03/23/94
LOCATION:	2LMW18D	2LMW18D	2LMW18D	2LMW18D	2LMW18S	2LMW18S	2LMW18S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE	10 U		10 UJ				2 J
DI-N-BUTYL PHTHALATE	10 U		10 UJ		10 UJ	10 UJ	10 U
DI-N-OCTYL PHTHALATE	10 U		10 UJ		10 UJ	10 UJ	10 U
DIBENZOFURAN	10 U		10 UJ		10 UJ	10 UJ	10 U
DIETHYL PHTHALATE	10 U		10 UJ		10 UJ	17 J	1 J
FLUORENE	10 U		10 UJ		10 UJ	10 UJ	1 J
N-NITROSODIPHENYLAMINE	10 U		10 UJ		10 UJ	10 UJ	10 U
NAPHTHALENE	10 U		10 UJ		15 J	20 J	42
PHENANTHRENE	10 U		10 UJ		10 UJ	10 UJ	10 U
PHENOL	0.7 J		10 UJ		10 UJ	10 UJ	10 U

PESTICIDES/PCBs (UG/L)

AROCLOR-1016					0.5 U	0.5 U	10 U
AROCLOR-1254					150	130	10 U
AROCLOR-1260					1 U	1 U	710

INORGANICS (UG/L)

ALUMINUM	24.0 J	14.0 U	204	15.0	51.1	63.5	99.3 U
ANTIMONY	20.6 J	15.0 U	12.0 U	12.0 U	25.0 U	25.0 U	15.0 U
ARSENIC	3.2 J	3.1 J	4.4 U	2.0 U	4.2	4.6	2.3 J
BARIUM	58.1	56.0	64.9	63.4	711	735	383
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	50.0 U	50.0 U	32.5 U	50.0 U	1.0 R	1.0 R	360
CADMIUM	2.0 U	2.1 J	2.0 U	2.0 U	29.1	28.6	2.0 U
CALCIUM	20100	20000	19100	19900	54600	53200	174000
CHROMIUM	3.0 U	3.0 U	3.0 U	3.9	5.0 U	5.0 U	3.0 UJ
COBALT	13.7 U	7.7 U	3.0 U	3.0 U	11.4	12.8	11.4 U
COPPER	2.0 U	2.0 U	6.6	2.0 U	5.0 U	7.0 J	5.8 U
IRON	5530 J	5440 J	55800	42700	192000	193000	144000
LEAD	2.0 UJ	2.0 UJ	2.7 U	2.0 U	10.0 U	10.0 U	2.0 U
MAGNESIUM	5230	5200	5180	5420	65900	66900	108000
MANGANESE	495	483	621	645	580	570	1140
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

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TABLE 6-9
**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
 AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW18D	2LGW18D	2LGW18D-2	2LGW18D-2	121390-2LMW18S	121390-2LMW19S	2LGW18S
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH1	PH2-1
SAMPLE DATE:	03/23/94	03/23/94	06/26/94	06/26/94	12/13/90	12/13/90	03/23/94
LOCATION:	2LMW18D	2LMW18D	2LMW18D	2LMW18D	2LMW18S	2LMW18S	2LMW18S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Unfiltered
INORGANICS (UG/L)							
NICKEL	10.0 U	10.0 U	7.0 U	7.0 U	29.5	28.6	21.4 U
POTASSIUM	1930	2270	2430	2190	47100	47600	36800
SELENIUM	3.0 UJ	3.0 UJ	2.0 U	2.0 U	2.9 J	2.6 J	3.0 U
SILVER	2.0 UJ	2.0 UJ	2.0 U	2.0 U	7.0 U	7.0 U	6.9 R
SODIUM	25200	25200	26600	27800	777000	788000	259000
THALLIUM	10.0 UR	10.0 UR	2.0 UR	20.0 U	10.0 U	10.0 U	10.0 UR
VANADIUM	5.0 U	5.0 U	3.0 U	3.0 U	20.0 U	20.0 U	5.0 U
ZINC	2.8 J	12.7	21.2 U	8.6	600	612	68.2
RADIONUCLIDES (PCI/L)							
GAMMA SPEC (K40)							ND
GROSS ALPHA					0 +/- 24.30	0 +/- 25.90	1 +/- 9.00 UJ
GROSS BETA					56.3 +/- 16.40	51.8 +/- 16.40	63 +/- 14.00 J
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3	72		76				890

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW18S	2LGW18S-2	2LGW18S-2	2LGW19D	2LGW19D	2LGW19D-2	2LGW19D-2
INVESTIGATION:	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	03/23/94	06/26/94	06/26/94	03/23/94	03/23/94	06/23/94	06/23/94
LOCATION:	2LMW18S	2LMW18S	2LMW18S	2LMW19D	2LMW19D	2LMW19D	2LMW19D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Deep	Deep	Deep	Deep
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE		100 U		10 U		10 U	
1,2-DICHLOROETHENE (TOTAL)		100 U		10 U		10 U	
4-METHYL-2-PENTANONE		100 U		10 U		10 U	
ACETONE		100 U		15 U		10 U	
BENZENE		32 J		10 U		10 U	
CARBON DISULFIDE		100 U		10 U		10 U	
CHLOROBENZENE		1200		10 U		10 U	
CHLOROFORM		16 J		10 U		10 U	
ETHYLBENZENE		100		10 U		10 U	
METHYLENE CHLORIDE		100 U		10 U		10 U	
TETRACHLOROETHENE		100 U		10 U		10 U	
TOLUENE		100 U		10 U		10 U	
TRICHLOROETHENE		100 U		10 U		10 U	
XYLENES, TOTAL		510		2 J		10 U	

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE		65		10 UJ		10 U	
1,2-DICHLOROBENZENE		8 J		10 U		10 U	
1,3-DICHLOROBENZENE		22		10 UJ		10 U	
1,4-DICHLOROBENZENE		55		10 UJ		10 U	
2,4-DICHLOROPHENOL		2 J		10 U		10 U	
2,4-DIMETHYLPHENOL		8 J		10 U		10 U	
2,4-DINITROTOLUENE		10 U		10 UJ		10 U	
2-CHLOROPHENOL		12		10 U		10 U	
2-METHYLNAPHTHALENE		5 J		10 UJ		10 U	
4-CHLORO-3-METHYLPHENOL		8 J		10 U		10 U	
4-METHYLPHENOL		0.6 J		10 U		10 U	
ACENAPHTHENE		10 U		10 UJ		10 U	
ANTHRACENE		0.5 J		10 U		10 U	
BENZOIC ACID		50 U		50 U		50 U	
BIS(2-ETHYLHEXYL)PHTHALATE		25		17 U		3 J	
BUTYL BENZYL PHTHALATE		10 U		10 UJ		10 U	

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW18S	2LGW18S-2	2LGW18S-2	2LGW19D	2LGW19D	2LGW19D-2	2LGW19D-2
INVESTIGATION:	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	03/23/94	06/26/94	06/26/94	03/23/94	03/23/94	06/23/94	06/23/94
LOCATION:	2LMW18S	2LMW18S	2LMW18S	2LMW19D	2LMW19D	2LMW19D	2LMW19D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Deep	Deep	Deep	Deep
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

SEMIVOLATILES (UG/L)

CARBAZOLE		0.8 J		10 UJ		10 U	
DI-N-BUTYL PHTHALATE		0.8 J		10 UJ		10 U	
DI-N-OCTYL PHTHALATE		10 U		2 J		10 U	
DIBENZOFURAN		10 U		10 U		10 U	
DIETHYL PHTHALATE		13		10 UJ		10 U	
FLUORENE		10 U		10 UJ		10 U	
N-NITROSODIPHENYLAMINE		1 J		10 U		10 U	
NAPHTHALENE		17		10 UJ		10 U	
PHENANTHRENE		10 U		10 U		10 U	
PHENOL		10 U		1 J		10 U	

PESTICIDES/PCBs (UG/L)

AROCLOR-1016		7.5 J					
AROCLOR-1254		1 UJ					
AROCLOR-1260		290 J					

INORGANICS (UG/L)

ALUMINUM	112 U	593	62.5	3340 J	14.0 U	90.0 U	15.0 U
ANTIMONY	15.0 UJ	12.0 UR	12.0 U	15.0 U	15.0 U	13.0 U	13.0 U
ARSENIC	5.0 J	6.2 U	2.6	4.9 J	2.8 J	2.3	1.0 U
BARIUM	352	564	523	281	172	257	265
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.5 J	1.4 J	1.0 U	1.0 U
BORON	359 J	303 J	290	50.0 U	50.0 U	50.0 U	50.0 U
CADMIUM	6.1 U	2.0 UR	2.0 U	2.0 U	2.0 U	3.0 U	3.0 U
CALCIUM	161000	58500	62800	80300	77600	94100	97800
CHROMIUM	3.0 U	7.2	6.7	32.5	3.0 U	4.0 U	4.0 U
COBALT	10.4 U	14.4 U	14.4	18.0 U	13.2 U	5.0 U	5.0 U
COPPER	3.4 U	10.1 R	3.8	42.7	2.0 U	5.0 U	5.0 U
IRON	142000	193000	193000	62200 J	2940 J	5350	304
LEAD	2.0 UJ	84.0	2.0 U	21.6 J	2.0 UJ	2.0 UJ	2.0 UJ
MAGNESIUM	97600	31200	30300	13100	12200	15200	15800
MANGANESE	1070	668	705	860	665	493	484
MERCURY	0.2 U	0.32 J	0.2 U	0.2 U	0.2	0.2 U	0.2 U

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TABLE 6-9**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW18S	2LGW18S-2	2LGW18S-2	2LGW19D	2LGW19D	2LGW19D-2	2LGW19D-2
INVESTIGATION:	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	03/23/94	06/26/94	06/26/94	03/23/94	03/23/94	06/23/94	06/23/94
LOCATION:	2LMW18S	2LMW18S	2LMW18S	2LMW19D	2LMW19D	2LMW19D	2LMW19D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Deep	Deep	Deep	Deep
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

INORGANICS (UG/L)

NICKEL	28.0 U	30.8	24.9	80.9	34.9	11.0 U	14.0
POTASSIUM	33900	29800	29300	7280	5930	5850	6120
SELENIUM	3.0 UJ	2.0 UJ	2.0 U	3.0 UJ	3.0	2.0 U	2.0 U
SILVER	12.5 U	4.0 U	2.0 U	3.5 J	2.0 UJ	2.0 U	2.0 U
SODIUM	227000	251000	235000	27600	26700	31400	32700
THALLIUM	10.0 UR	20.0 UR	20.0 U	10.0 UR	10.0 UR	10.0 UJ	10.0 UJ
VANADIUM	5.0 U	3.0 U	3.0 U	5.0 U	5.0 U	4.0 U	4.0 U
ZINC	68.9	218	74.0	112 J	6.4	7.4	7.4

RADIONUCLIDES (PCI/L)

GAMMA SPEC (K40)		45 +/- 61.00					
GROSS ALPHA		11 +/- 6.00					
GROSS BETA		36 +/- 9.00					

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO3		84		260		304	
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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW19S	2LGW19S	2LGW19S-2	2LGW19S-2	2LGW20D	2LGW20D	2LGW20D-2
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2
SAMPLE DATE:	01/23/94	01/23/94	07/10/94	07/10/94	04/06/94	04/06/94	07/08/94
LOCATION:	2LMW19S	2LMW19S	2LMW19S	2LMW19S	2LMW20D	2LMW20D	2LMW20D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	10 U		10 U		10 U		10 U
1,2-DICHLOROETHENE (TOTAL)	10 U		10 U		10 U		10 U
4-METHYL-2-PENTANONE	10 U		10 U		10 U		10 U
ACETONE	10 U		10 U		10 UJ		10 U
BENZENE	10 U		10 U		10 U		10 U
CARBON DISULFIDE	10 U		10 U		10 U		10 U
CHLOROBENZENE	10 U		10 U		10 U		10 U
CHLOROFORM	10 U		10 U		10 U		10 U
ETHYLBENZENE	10 U		10 U		10 U		10 U
METHYLENE CHLORIDE	10 U		17 U		12 U		10 U
TETRACHLOROETHENE	10 U		10 U		10 U		10 U
TOLUENE	10 U		10 U		10 U		10 U
TRICHLOROETHENE	10 U		10 U		10 U		10 U
XYLENES, TOTAL	10 U		10 U		10 U		10 U

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U		10 U		10 U		10 U
1,2-DICHLOROBENZENE	10 U		10 U		10 U		10 U
1,3-DICHLOROBENZENE	10 U		10 U		10 U		10 U
1,4-DICHLOROBENZENE	10 U		10 U		10 U		10 U
2,4-DICHLOROPHENOL	10 U		10 U		10 U		10 U
2,4-DIMETHYLPHENOL	10 U		10 U		10 U		10 U
2,4-DINITROTOLUENE	10 U		10 U		10 U		10 U
2-CHLOROPHENOL	10 U		10 U		10 U		10 U
2-METHYLNAPHTHALENE	10 U		10 U		10 U		10 U
4-CHLORO-3-METHYLPHENOL	10 U		10 U		10 U		10 U
4-METHYLPHENOL	10 U		10 U		10 U		10 U
ACENAPHTHENE	10 U		10 U		10 U		10 U
ANTHRACENE	10 U		10 U		10 U		10 U
BENZOIC ACID	50 U		50 U		0.9 J		2 J
BIS(2-ETHYLHEXYL)PHTHALATE	10 U		10 U		10 U		10 U
BUTYL BENZYL PHTHALATE	10 U		10 U		10 U		10 U

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW19S	2LGW19S	2LGW19S-2	2LGW19S-2	2LGW20D	2LGW20D	2LGW20D-2
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2
SAMPLE DATE:	01/23/94	01/23/94	07/10/94	07/10/94	04/06/94	04/06/94	07/08/94
LOCATION:	2LMW19S	2LMW19S	2LMW19S	2LMW19S	2LMW20D	2LMW20D	2LMW20D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE	10 U		10 U		10 U		10 U
DI-N-BUTYL PHTHALATE	10 U		10 U		10 U		10 U
DI-N-OCTYL PHTHALATE	10 U		10 U		10 U		10 U
DIBENZOFURAN	10 U		10 U		10 U		10 U
DIETHYL PHTHALATE	10 U		10 U		10 U		10 U
FLUORENE	10 U		10 U		10 U		10 U
N-NITROSODIPHENYLAMINE	10 U		10 U		10 U		10 U
NAPHTHALENE	10 U		10 U		10 U		10 U
PHENANTHRENE	10 U		10 U		10 U		10 U
PHENOL	10 U		10 U		0.7 J		10 U

INORGANICS (UG/L)

ALUMINUM	124	100 U	10300	116 U	172 U	41.5 U	205 U
ANTIMONY	15.0 U	17.2 J	12.0 U	12.0 U	13.0 U	13.0 U	12.0 U
ARSENIC	2.0 U	2.0 U	5.0 J	5.0 U	2.8 J	2.0 U	3.0 U
BARIUM	98.7	103	503	386	231	220	126
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	50.0 UJ	51.7 J	58.8 U	40.5 U	31.2 U	50.0 U	34.7 U
CADMIUM	2.0 U	2.0 U	2.0 U	2.0 U	3.0 U	3.0 U	2.0 U
CALCIUM	18200 J	19200	90600	90900	40400	35000	26700
CHROMIUM	3.0 U	3.0 U	12.4	4.4 U	4.0 U	4.0 U	5.0 J
COBALT	4.0 U	4.0 U	9.2	3.1 U	10.0 J	6.3 U	24.8
COPPER	2.0 U	2.0 U	9.8	2.7 U	5.0 U	5.0 U	11.8
IRON	55.1 J	12.1 U	12600	96.8 J	12100	1480	49300
LEAD	1.0 U	1.0 U	9.3 U	2.0 U	2.6 J	2.0 UJ	3.4 J
MAGNESIUM	4550	4690	25400	20700	8500	8470	5340
MANGANESE	203	216	1620	1570	266	159	705
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ
NICKEL	10.0 U	10.0 U	7.0 U	9.0 J	14.6 J	14.0	59.2 U
POTASSIUM	2690	3050	13000	10800	3770 J	3660	3540
SELENIUM	1.0 U	1.0 UJ	5.0 UJ	5.0 UJ	1.0 U	1.0 U	3.0 U
SILVER	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

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TABLE 6-9
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW19S	2LGW19S	2LGW19S-2	2LGW19S-2	2LGW20D	2LGW20D	2LGW20D-2
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2
SAMPLE DATE:	01/23/94	01/23/94	07/10/94	07/10/94	04/06/94	04/06/94	07/08/94
LOCATION:	2LMW19S	2LMW19S	2LMW19S	2LMW19S	2LMW20D	2LMW20D	2LMW20D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

INORGANICS (UG/L)

SODIUM	17500	18000	43200	44100	78200	78300	49900
THALLIUM	1.0 UJ	1.0 UJ	5.0 U	5.0 U	1.1 U	1.3 U	2.0 UJ
VANADIUM	5.0 U	5.0 U	30.3	1.0 U	4.0 U	4.0 U	3.8 U
ZINC	2.8 J	2.3 J	61.7	9.1 U	28.4	20.4 U	70.6

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO3			322		136		84
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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW20D-2	2LGW20S	2LGW20S	2LGW20S-2	2LGW20S-D-2	2LGW20S-2	2LGW20SD-2
INVESTIGATION:	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2	PH2-2	PH2-2
SAMPLE DATE:	07/08/94	01/23/94	01/23/94	07/08/94	07/08/94	07/08/94	07/08/94
LOCATION:	2LMW20D	2LMW20S	2LMW20S	2LMW20S	2LMW20S	2LMW20S	2LMW20S
SCREEN DEPTH:	Deep	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Filtered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE		10 U		10 U	10 U		
1,2-DICHLOROETHENE (TOTAL)		10 U		10 U	10 U		
4-METHYL-2-PENTANONE		10 U		10 U	10 U		
ACETONE		10 U		10 U	10 U		
BENZENE		10 U		10 U	10 U		
CARBON DISULFIDE		10 U		10 U	10 U		
CHLOROBENZENE		10 U		10 U	10 U		
CHLOROFORM		10 U		10 U	10 U		
ETHYLBENZENE		10 U		10 U	10 U		
METHYLENE CHLORIDE		10 U		10 U	8 J		
TETRACHLOROETHENE		10 U		10 U	10 U		
TOLUENE		10 U		10 U	10 U		
TRICHLOROETHENE		10 U		10 U	10 U		
XYLENES, TOTAL		10 U		10 U	10 U		

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE		10 U		10 U	10 U		
1,2-DICHLOROBENZENE		10 U		10 U	10 U		
1,3-DICHLOROBENZENE		10 U		10 U	10 U		
1,4-DICHLOROBENZENE		10 U		10 U	10 U		
2,4-DICHLOROPHENOL		10 U		10 U	10 U		
2,4-DIMETHYLPHENOL		10 U		10 U	10 U		
2,4-DINITROTOLUENE		10 U		10 U	10 U		
2-CHLOROPHENOL		10 U		10 U	10 U		
2-METHYLNAPHTHALENE		10 U		10 U	10 U		
4-CHLORO-3-METHYLPHENOL		10 U		10 U	10 U		
4-METHYLPHENOL		10 U		10 U	10 U		
ACENAPHTHENE		10 U		10 U	10 U		
ANTHRACENE		10 U		10 U	10 U		
BENZOIC ACID		50 U		1 J	1 J		
BIS(2-ETHYLHEXYL)PHTHALATE		10 U		10 U	10 U		
BUTYL BENZYL PHTHALATE		10 U		10 U	10 U		

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TABLE 6-9**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW20D-2	2LGW20S	2LGW20S	2LGW20S-2	2LGW20S-D-2	2LGW20S-2	2LGW20SD-2
INVESTIGATION:	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2	PH2-2	PH2-2
SAMPLE DATE:	07/08/94	01/23/94	01/23/94	07/08/94	07/08/94	07/08/94	07/08/94
LOCATION:	2LMW20D	2LMW20S	2LMW20S	2LMW20S	2LMW20S	2LMW20S	2LMW20S
SCREEN DEPTH:	Deep	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Filtered

SEMIVOLATILES (UG/L)

CARBAZOLE		10 U		10 U	10 U		
DI-N-BUTYL PHTHALATE		10 U		10 U	10 U		
DI-N-OCTYL PHTHALATE		10 U		10 U	10 U		
DIBENZOFURAN		10 U		10 U	10 U		
DIETHYL PHTHALATE		10 U		10 U	10 U		
FLUORENE		10 U		10 U	10 U		
N-NITROSODIPHENYLAMINE		10 U		10 U	10 U		
NAPHTHALENE		10 U		10 U	10 U		
PHENANTHRENE		10 U		10 U	10 U		
PHENOL		10 U		10 U	10 U		

INORGANICS (UG/L)

ALUMINUM	52.0 U	116 U	26.2 U	4650	4210	72.3 U	41.8 U
ANTIMONY	13.4 U	15.0 U	15.0 U	12.0 U	12.0 U	12.0 U	12.0 U
ARSENIC	5.0 U	2.0 U	2.0 U	7.9 U	4.5 U	5.0 U	5.0 U
BARIUM	119	57.4	57.6	113	116	97.7	103
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	11.8 J	52.5 J	52.4 J	52.9 U	62.4 U	39.3	49.1
CADMIUM	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
CALCIUM	23400	35100 J	35900	62600	62400	65300	71400
CHROMIUM	3.0 U	3.0 U	3.0 U	6.6	4.9 J	3.0 U	4.2 U
COBALT	8.0 U	4.0 U	4.0 U	3.5 J	4.4 J	3.0 U	3.0 U
COPPER	2.0 U	2.0 U	2.0 U	8.2	7.8	2.0 U	2.0 U
IRON	20700	4390 J	4440	18100	18700	14800	15900
LEAD	2.0 U	1.0 U	1.0 U	9.4	9.4	2.4 J	6.2
MAGNESIUM	5370	6160	6190	10900	11100	10900	11600
MANGANESE	554	1060	1070	1780	1790	1830	2010
MERCURY	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 U	0.2 U
NICKEL	7.0 U	10.0 U	10.0 U	8.3 U	11.2 U	7.0 U	7.0 U
POTASSIUM	3140	4400	4560	7120	7250	6390	6710
SELENIUM	5.0 UJ	1.3 U	1.0 UJ	3.0 U	3.0 U	5.0 UJ	5.0 UJ
SILVER	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.1 U	2.0 U

TABLE 6-9**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW20D-2	2LGW20S	2LGW20S	2LGW20S-2	2LGW20S-D-2	2LGW20S-2	2LGW20SD-2
INVESTIGATION:	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2	PH2-2	PH2-2
SAMPLE DATE:	07/08/94	01/23/94	01/23/94	07/08/94	07/08/94	07/08/94	07/08/94
LOCATION:	2LMW20D	2LMW20S	2LMW20S	2LMW20S	2LMW20S	2LMW20S	2LMW20S
SCREEN DEPTH:	Deep	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Filtered
INORGANICS (UG/L)							
SODIUM	52100	29600	29600	44600	45200	44900	44100
THALLIUM	5.0 U	1.0 UJ	1.0 UJ	2.0 J	3.7 J	5.8 J	5.0 U
VANADIUM	3.0 U	5.0 U	5.1 J	48.8	45.8	3.0 U	3.1 J
ZINC	16.1 U	3.3 J	4.9 J	26.3 U	23.6 U	10.1 U	8.9 U
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃				196	192		

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	010891-2LMW7D	010891-2LMW21D	2LGW7D	2LGW7D	2LGW7D-2	2LGW7D-2	010391-2LMW7S
INVESTIGATION:	PH1	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	01/08/91	01/08/91	03/20/94	03/20/94	06/27/94	06/27/94	01/02/91
LOCATION:	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Shallow
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	5 U	5 U	10 U		10 U		5 U
1,2-DICHLOROETHENE (TOTAL)	5 U	5 U	10 U		10 U		5 U
4-METHYL-2-PENTANONE	10 U	10 U	10 U		10 U		10 U
ACETONE	10 U	10 U	10 U		10 U		10 U
BENZENE	5 U	5 U	10 U		10 U		5 U
CARBON DISULFIDE	5 U	5 U	10 U		10 U		5 U
CHLOROBENZENE	5 U	5 U	10 U		10 U		5 U
CHLOROFORM	5 U	5 U	10 U		10 U		5 U
ETHYLBENZENE	5 U	5 U	10 U		10 U		5 U
METHYLENE CHLORIDE	5 U	5 U	10 U		10 U		5 U
TETRACHLOROETHENE	5 U	5 U	10 U		10 U		5 U
TOLUENE	5 U	5 U	10 U		10 U		5 U
TRICHLOROETHENE	5 U	5 U	10 U		10 U		5 U
XYLENES, TOTAL	5 U	5 U	10 U		10 U		5 U

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U	10 U	10 U		10 U		10 U
1,2-DICHLOROBENZENE	10 U	10 U	10 U		10 U		10 U
1,3-DICHLOROBENZENE	10 U	10 U	10 U		10 U		10 U
1,4-DICHLOROBENZENE	10 U	10 U	10 U		10 U		10 U
2,4-DICHLOROPHENOL	10 U	10 U	10 U		10 U		10 U
2,4-DIMETHYLPHENOL	10 U	10 U	10 U		10 U		10 U
2,4-DINITROTOLUENE	10 U	10 U	10 U		10 U		10 U
2-CHLOROPHENOL	10 U	10 U	10 U		10 U		10 U
2-METHYLNAPHTHALENE	10 U	10 U	10 U		10 U		10 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U	10 U		10 U		10 U
4-METHYLPHENOL	10 U	10 U	10 U		10 U		10 U
ACENAPHTHENE	10 U	10 U	10 U		10 U		10 U
ANTHRACENE	10 U	10 U	10 U		10 U		10 U
BENZOIC ACID	50 U	50 U	50 U		50 U		50 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U	10 U		10 U		10 U
BUTYL BENZYL PHTHALATE	10 U	10 U	10 U		10 U		10 U

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	010891-2LMW7D	010891-2LMW21D	2LGW7D	2LGW7D	2LGW7D-2	2LGW7D-2	010391-2LMW7S
INVESTIGATION:	PH1	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	01/08/91	01/08/91	03/20/94	03/20/94	06/27/94	06/27/94	01/02/91
LOCATION:	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Shallow
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE			10 U		10 U		
DI-N-BUTYL PHTHALATE	10 U	10 U	10 U		10 U		10 U
DI-N-OCTYL PHTHALATE	10 U	10 U	10 U		10 U		10 U
DIBENZOFURAN	10 U	10 U	10 U		10 U		10 U
DIETHYL PHTHALATE	10 U	10 U	10 U		10 U		10 U
FLUORENE	10 U	10 U	10 U		10 U		10 U
N-NITROSODIPHENYLAMINE	10 U	10 U	10 U		10 U		10 U
NAPHTHALENE	10 U	10 U	10 U		10 U		10 U
PHENANTHRENE	10 U	10 U	10 U		10 U		10 U
PHENOL	10 U	10 U	10 U		10 U		10 U

PESTICIDES/PCBs (UG/L)

AROCLOR-1016	0.5 U	0.5 U					0.52 U
AROCLOR-1254	1 U	1 U					1 U
AROCLOR-1260	1 U	1 U					1 U

INORGANICS (UG/L)

ALUMINUM	30.0 U	30.0 U	80.5 U	54.1 U	121 J	13.0 U	30.0 U
ANTIMONY	25.0 U	25.0 U	15.0 U	15.0 UJ	12.0 U	12.0 U	25.0 U
ARSENIC	3.0 U	3.0 U	2.0 U	2.0 UJ	3.6 J	3.6 J	3.0 U
BARIUM	57.4	57.8	135	119	142 J	118	25.0
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	2.1 R	2.1 R	57.8 J	57.3 J	113 U	80.6 U	1.2 R
CADMIUM	3.8 J	2.6 J	2.0 U	2.0 U	1.7 J	1.0 U	2.0 U
CALCIUM	13900	13900	27900	27000	30000	28300	26000
CHROMIUM	5.0 U	5.0 U	3.0 UJ	3.0 U	4.2 J	3.0 U	11.5 J
COBALT	5.0 U	5.0 U	12.7 U	5.3 U	3.5 U	1.5 U	5.3
COPPER	6.1 J	7.5 J	8.0 U	2.0 U	9.3	3.0 U	5.0 U
IRON	28100	27800	44000	3520	83900	20700	13600
LEAD	2.0 UJ	2.0 UJ	2.0 U	2.0 UJ	2.2 U	1.0 U	8.5 J
MAGNESIUM	4040	4010	6700	6590	7310	7010	36200
MANGANESE	216	213	235	76.4	700 J	279	280
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 UJ

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	010891-2LMW7D	010891-2LMW21D	2LGW7D	2LGW7D	2LGW7D-2	2LGW7D-2	010391-2LMW7S
INVESTIGATION:	PH1	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	01/08/91	01/08/91	03/20/94	03/20/94	06/27/94	06/27/94	01/02/91
LOCATION:	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7D	2LMW7S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Shallow
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
INORGANICS (UG/L)							
NICKEL	21.1 J	22.0 J	17.8 U	10.0 U	13.7	3.9	16.8 J
POTASSIUM	3290	3420	5680	5580	6360	6420	16400
SELENIUM	1.0 U	1.0 U	3.0 U	3.0 UJ	3.0 UJ	3.0 UJ	2.9
SILVER	7.0 U	7.0 U	2.5 J	2.0 UJ	2.0 U	2.0 U	7.0 U
SODIUM	89200	88800	123000	122000	141000	135000	365000
THALLIUM	2.0 U	2.0 U	10.0 UR	10.0 UR	20.0 UJ	2.0 UJ	2.0 UR
VANADIUM	20.0 U	20.0 U	5.0 U	5.0 U	3.0 U	3.0 U	20.0 U
ZINC	11.0 J	8.3 J	14.7	3.8 J	20.2 J	16.0	10.5 J
RADIONUCLIDES (PCI/L)							
GROSS ALPHA	1.3 +/- 2.60						11 +/- 22.50
GROSS BETA	6.6 +/- 3.30						20.9 +/- 14.70
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3			100		100		

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW7S	2LGW7S	2LGW7S-2	2LGW7S-2	121790-2LMW8D	2LGW8D	2LGW8D
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	01/25/94	01/25/94	06/27/94	06/27/94	12/17/90	03/20/94	03/20/94
LOCATION:	2LMW7S	2LMW7S	2LMW7S	2LMW7S	2LMW8D	2LMW8D	2LMW8D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	10 U		10 U		5 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	10 U		10 U		5 U	10 U	
4-METHYL-2-PENTANONE	10 U		10 U		10 U	10 U	
ACETONE	10 U		10 U		10 U	10 U	
BENZENE	10 U		10 U		5 U	10 U	
CARBON DISULFIDE	10 U		3 J		5 U	10 U	
CHLOROBENZENE	10 U		10 U		5 U	10 U	
CHLOROFORM	10 U		10 U		5 U	10 U	
ETHYLBENZENE	10 U		10 U		5 U	10 U	
METHYLENE CHLORIDE	10 U		10 U		5 U	10 U	
TETRACHLOROETHENE	10 U		10 U		5 U	10 U	
TOLUENE	10 U		10 U		5 U	10 U	
TRICHLOROETHENE	10 U		10 U		5 U	10 U	
XYLENES, TOTAL	10 U		2 J		5 U	10 U	

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U		10 U		10 U	10 U	
1,2-DICHLOROBENZENE	10 U		10 U		10 U	10 U	
1,3-DICHLOROBENZENE	10 U		10 U		10 U	10 U	
1,4-DICHLOROBENZENE	10 U		10 U		10 U	10 U	
2,4-DICHLOROPHENOL	10 U		10 U		10 U	10 U	
2,4-DIMETHYLPHENOL	10 U		10 U		10 U	10 U	
2,4-DINITROTOLUENE	7 J		10 U		10 U	10 U	
2-CHLOROPHENOL	10 U		10 U		10 U	10 U	
2-METHYLNAPHTHALENE	10 U		10 U		10 U	10 U	
4-CHLORO-3-METHYLPHENOL	10 U		10 U		10 U	10 U	
4-METHYLPHENOL	10 U		10 U		10 U	10 U	
ACENAPHTHENE	1 J		10 U		10 U	10 U	
ANTHRACENE	10 U		10 U		10 U	10 U	
BENZOIC ACID	10 UJ		50 U		50 U	50 UJ	
BIS(2-ETHYLHEXYL)PHTHALATE	1		62 J		10 U	10 U	
BUTYL BENZYL PHTHALATE	10 U		10 U		10 U	10 U	

TABLE 6-9**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW7S	2LGW7S	2LGW7S-2	2LGW7S-2	121790-2LMW8D	2LGW8D	2LGW8D
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	01/25/94	01/25/94	06/27/94	06/27/94	12/17/90	03/20/94	03/20/94
LOCATION:	2LMW7S	2LMW7S	2LMW7S	2LMW7S	2LMW8D	2LMW8D	2LMW8D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered

SEMIVOLATILES (UG/L)

CARBAZOLE	10 UJ		10 U			10 U	
DI-N-BUTYL PHTHALATE	10 U		10 U		10 U	10 U	
DI-N-OCTYL PHTHALATE	10 U		10 U		10 U	10 U	
DIBENZOFURAN	10 U		10 U		10 U	10 U	
DIETHYL PHTHALATE	1 J		10 U		10 U	10 U	
FLUORENE	1 J		10 U		10 U	10 U	
N-NITROSODIPHENYLAMINE	10 U		10 U		10 U	10 U	
NAPHTHALENE	10 U		10 U		10 U	10 U	
PHENANTHRENE	10 U		10 U		10 U	10 U	
PHENOL	10 U		10 U		10 U	10 U	

PESTICIDES/PCBs (UG/L)

AROCLOR-1016					0.56 U		
AROCLOR-1254					1.1 U		
AROCLOR-1260					1.1 U		

INORGANICS (UG/L)

ALUMINUM	79.6 U	14.0 U	3960 J	10.0 U	30.0 U	122 U	65.2 U
ANTIMONY	15.0 U	15.0 U	12.0 U	19.9 U	25.0 U	15.0 U	15.0 UJ
ARSENIC	5.1 J	5.0 J	37.0	20.0 U	3.0 U	2.6 J	2.0 UJ
BARIUM	52.1	49.3	61.5 J	48.0 U	15.0 U	8.7 J	5.0 U
BERYLLIUM	1.0 U	1.0 U	1.1 J	1.0 U	1.0 U	1.0 U	1.0 U
BORON	719 U	751	3010 J	2670	1.2 R	50.0 U	50.0 U
CADMIUM	2.0 U	2.0 U	2.4 R	2.0 UR	2.0 U	2.0 U	2.0 U
CALCIUM	56100	56400	143000	147000	33400	44300	41600
CHROMIUM	5.4 U	5.9 U	23.2 J	6.0 U	5.0 U	3.0 UJ	3.0 U
COBALT	4.0 U	4.5	4.0 U	3.0 U	5.0 U	15.6 U	4.0 U
COPPER	2.5	2.7	13.3	30.1 J	6.2 J	2.0 U	2.0 U
IRON	18900	17600	51100	164 J	41.9 J	24600	20.0 U
LEAD	1.0 UJ	1.0 UJ	13.9	10.0 UJ	3.8	2.0 U	2.0 UJ
MAGNESIUM	127000	127000	563000	451000	2210	3010	2960
MANGANESE	301	292	175 J	36.8	57.5 J	92.0	12.1
MERCURY	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.2 U

TABLE 6-9**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW7S	2LGW7S	2LGW7S-2	2LGW7S-2	121790-2LMW8D	2LGW8D	2LGW8D
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	01/25/94	01/25/94	06/27/94	06/27/94	12/17/90	03/20/94	03/20/94
LOCATION:	2LMW7S	2LMW7S	2LMW7S	2LMW7S	2LMW8D	2LMW8D	2LMW8D
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered

INORGANICS (UG/L)

NICKEL	10.0 U	10.0 U	9.3	15.7 U	7.0 U	10.0 U	10.0 U
POTASSIUM	43000	43700	208000	172000	1420 J	1020 U	701 U
SELENIUM	3.0 UJ	3.0 UJ	30.0 UJ	10.0 UJ	1.0 J	3.0 U	3.0 UJ
SILVER	2.0 U	2.2 U	2.0 U	2.0 U	7.0 U	2.0 UJ	2.0 UJ
SODIUM	1070000 J	1060000 J	5230000	4570000	11400	12700	12300
THALLIUM	10.0 UJ	1.0 UJ	20.0 UJ	2.0 UJ	2.0 U	1.0 UR	1.0 UR
VANADIUM	5.7	5.0 U	24.7 J	11.4 U	20.0 U	5.0 U	5.0 U
ZINC	2.0 U	2.0 U	42.5 J	2.0 UJ	2.0 UJ	2.0 U	2.4 J

RADIONUCLIDES (PCI/L)

GAMMA SPEC (K40)	250 +/- 100.00		130 +/- 70.00				
GROSS ALPHA	3 +/- 13.00 U		6 +/- 34.00		0 +/- 2.20		
GROSS BETA	43 +/- 19.00		85 +/- 48.00		2.9 +/- 2.90		

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO3	1180		2900			124	
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TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW8D-2	2LGW8D-2	121490-2LMW8S	2LGW8S	2LGW8S	2LGW8S-2	2LGW8S-2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	06/27/94	06/27/94	12/14/90	01/26/94	01/26/94	06/26/94	06/26/94
LOCATION:	2LMW8D	2LMW8D	2LMW8S	2LMW8S	2LMW8S	2LMW8S	2LMW8S
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	10 U		5 U	10 U		10 U	
1,2-DICHLOROETHENE (TOTAL)	10 U		5 U	10 U		10 U	
4-METHYL-2-PENTANONE	10 U		10 U	10 U		10 U	
ACETONE	10 U		10 U	10 U		10 U	
BENZENE	10 U		5 U	10 U		10 U	
CARBON DISULFIDE	10 U		5 U	10 U		10 U	
CHLOROBENZENE	10 U		5 U	10 U		10 U	
CHLOROFORM	10 U		5 U	10 U		10 U	
ETHYLBENZENE	10 U		2 J	10 U		10 U	
METHYLENE CHLORIDE	10 U		5 U	10 U		34 U	
TETRACHLOROETHENE	10 U		5 U	10 U		10 U	
TOLUENE	10 U		5 U	10 U		10 U	
TRICHLOROETHENE	10 U		5 U	10 U		10 U	
XYLENES, TOTAL	10 U		2 J	10 U		10 U	

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U		10 U	10 U		10 U	
1,2-DICHLOROBENZENE	10 U		10 U	10 U		10 U	
1,3-DICHLOROBENZENE	10 U		10 U	10 U		10 U	
1,4-DICHLOROBENZENE	10 U		10 U	10 U		10 U	
2,4-DICHLOROPHENOL	10 U		10 U	10 U		10 U	
2,4-DIMETHYLPHENOL	10 U		10 U	10 U		10 U	
2,4-DINITROTOLUENE	10 U		10 U	10 U		10 U	
2-CHLOROPHENOL	10 U		10 U	10 U		10 U	
2-METHYLNAPHTHALENE	10 U		10 U	10 U		10 U	
4-CHLORO-3-METHYLPHENOL	10 U		10 U	10 U		10 U	
4-METHYLPHENOL	10 U		10 U	10 U		10 U	
ACENAPHTHENE	10 U		10 U	10 U		10 U	
ANTHRACENE	10 U		10 U	10 U		10 U	
BENZOIC ACID	50 U		50 U	1 J		50 U	
BIS(2-ETHYLHEXYL)PHTHALATE	17 U		10 U	54		10 U	
BUTYL BENZYL PHTHALATE	0.5 J		10 U	1 J		10 U	

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TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW8D-2	2LGW8D-2	121490-2LMW8S	2LGW8S	2LGW8S	2LGW8S-2	2LGW8S-2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	06/27/94	06/27/94	12/14/90	01/26/94	01/26/94	06/26/94	06/26/94
LOCATION:	2LMW8D	2LMW8D	2LMW8S	2LMW8S	2LMW8S	2LMW8S	2LMW8S
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered

SEMIVOLATILES (UG/L)

CARBAZOLE	10 U			10 UJ		10 U	
DI-N-BUTYL PHTHALATE	10 U		10 U	10 U		10 U	
DI-N-OCTYL PHTHALATE	10 U		10 U	10 U		10 U	
DIBENZOFURAN	10 U		10 U	10 U		10 U	
DIETHYL PHTHALATE	10 U		10 U	10 U		10 U	
FLUORENE	10 U		10 U	10 U		10 U	
N-NITROSODIPHENYLAMINE	10 U		10 U	10 U		10 U	
NAPHTHALENE	10 U		3 J	10 U		2 J	
PHENANTHRENE	10 U		10 U	10 U		10 U	
PHENOL	10 U		10 U	10 U		10 U	

PESTICIDES/PCBs (UG/L)

AROCLOR-1016			0.51 U				
AROCLOR-1254			1 U				
AROCLOR-1260			1 U				

INORGANICS (UG/L)

ALUMINUM	61.3 J	16.7	30.0 U	47.5 U	14.0 U	100 U	12.8
ANTIMONY	3.0 U	19.4	25.0 U	15.0 U	15.0 U	19.3 U	12.0 U
ARSENIC	3.0	2.0 U	3.0 U	2.0 UJ	2.0 UJ	3.6 U	2.5
BARIUM	9.7	6.0 U	33.4	39.0	5.0 U	45.6	50.5
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	50.0 U	23.3	1.2 R	50.0 U	50.0 U	38.5 U	50.0 U
CADMIUM	1.0 U	2.0 U	3.8	2.0 U	2.0 U	2.0 U	2.0 U
CALCIUM	52800	38100	14100	10800	157 U	19900	21300
CHROMIUM	2.3	3.0 U	5.0 U	3.0 U	3.0 U	3.2 J	3.0 U
COBALT	3.2	3.0 U	5.0 U	4.0 U	4.0 U	7.4 U	5.6
COPPER	5.3 U	4.8	7.1 J	2.0 U	2.0 U	2.0 U	2.0 U
IRON	53800	22.7	8360	3210	46.4	13900	12600
LEAD	2.0 UJ	2.0 U	3.0	1.0 UJ	1.0 UJ	2.0 UJ	2.0 U
MAGNESIUM	3020	2730	2440	2650	106 U	4350	4630
MANGANESE	309	39.9	544	126	9.1	420	470
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.29	0.2 U	0.2 U

TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW8D-2	2LGW8D-2	121490-2LMW8S	2LGW8S	2LGW8S	2LGW8S-2	2LGW8S-2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	06/27/94	06/27/94	12/14/90	01/26/94	01/26/94	06/26/94	06/26/94
LOCATION:	2LMW8D	2LMW8D	2LMW8S	2LMW8S	2LMW8S	2LMW8S	2LMW8S
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered

INORGANICS (UG/L)

NICKEL	12.0 U	7.0 U	7.0 U	10.0 U	10.0 U	7.0 U	7.0 U
POTASSIUM	865 J	1450	3560 J	2490	1000 U	3510	3290
SELENIUM	2.0 U	2.0 U	1.0 J	3.0 U	3.0 UJ	2.0 U	2.0 U
SILVER	1.0 U	2.0 U	7.0 U	2.0 U	2.0 U	2.0 U	2.0 U
SODIUM	13700	12400	12600	15400	104 U	23300	25100
THALLIUM	20.0 UR	2.0 U	2.0 U	1.0 UJ	1.0 UJ	2.0 U	20.0 U
VANADIUM	1.0 U	3.0 U	20.0 U	5.0 U	5.6	3.0 U	3.0 U
ZINC	8.4	6.5	13.2 J	3.4 U	2.0 U	6.7 U	8.1

RADIONUCLIDES (PCI/L)

GROSS ALPHA			1.2 +/- 1.30				
GROSS BETA			3.7 +/- 2.80				

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO3	132			420		64	
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TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	011091-2LMW9D	2LGW9D	2LGW9D	2LGW9D-2	2LGW9D-2	010291-2LMW9S	2LGW9S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1
SAMPLE DATE:	01/10/91	03/21/94	03/21/94	07/06/94	07/06/94	01/02/91	01/25/94
LOCATION:	2LMW9D	2LMW9D	2LMW9D	2LMW9D	2LMW9D	2LMW9S	2LMW9S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	5 U	10 U		10 U		5 U	10 U
1,2-DICHLOROETHENE (TOTAL)	5 U	10 U		10 U		5 U	10 U
4-METHYL-2-PENTANONE	10 U	10 U		10 U		10 U	10 U
ACETONE	19 U	10 U		10 U		10 U	10 J
BENZENE	5 U	10 U		10 U		5 U	10 U
CARBON DISULFIDE	5 U	10 U		10 U		5 U	1 J
CHLOROBENZENE	5 U	10 U		10 U		5 U	10 U
CHLOROFORM	5 U	10 U		10 U		5 U	10 U
ETHYLBENZENE	5 U	10 U		10 U		5 U	10 U
METHYLENE CHLORIDE	5 U	10 U		10 U		5 U	10 U
TETRACHLOROETHENE	5 U	10 U		10 U		5 U	10 U
TOLUENE	5 U	10 U		10 U		5 U	10 U
TRICHLOROETHENE	5 U	10 U		10 U		5 U	10 U
XYLENES, TOTAL	5 U	10 U		10 U		5 U	10 U

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE	10 U	10 U		10 U		10 U	10 U
1,2-DICHLOROBENZENE	10 U	10 U		10 U		10 U	10 U
1,3-DICHLOROBENZENE	10 U	10 U		10 U		10 U	10 U
1,4-DICHLOROBENZENE	10 U	10 U		10 U		10 U	10 U
2,4-DICHLOROPHENOL	10 U	10 U		10 U		10 U	10 U
2,4-DIMETHYLPHENOL	10 U	10 U		10 U		10 U	10 U
2,4-DINITROTOLUENE	10 U	10 U		10 U		10 U	10 U
2-CHLOROPHENOL	10 U	10 U		10 U		10 U	10 U
2-METHYLNAPHTHALENE	10 U	10 U		10 U		10 U	10 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U		10 U		10 U	10 U
4-METHYLPHENOL	10 U	10 U		10 U		7 J	10 U
ACENAPHTHENE	10 U	10 U		10 U		10 U	1 J
ANTHRACENE	10 U	10 U		10 U		10 U	10 U
BENZOIC ACID	50 U	50 U		0.5 J		4 J	10 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U		10 U		10 U	1
BUTYL BENZYL PHTHALATE	10 U	10 U		10 U		10 U	10 U

TABLE 6-9
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	011091-2LMW9D	2LW9D	2LW9D	2LW9D-2	2LW9D-2	010291-2LMW9S	2LW9S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1
SAMPLE DATE:	01/10/91	03/21/94	03/21/94	07/06/94	07/06/94	01/02/91	01/25/94
LOCATION:	2LMW9D	2LMW9D	2LMW9D	2LMW9D	2LMW9D	2LMW9S	2LMW9S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE		10 U		10 U			10 UJ
DI-N-BUTYL PHTHALATE	10 U	10 U		1 J		10 U	1 J
DI-N-OCTYL PHTHALATE	10 U	10 U		10 U		10 U	10 U
DIBENZOFURAN	10 U	10 U		10 U		10 U	10 U
DIETHYL PHTHALATE	10 U	10 U		10 U		10 U	10 U
FLUORENE	10 U	10 U		10 U		10 U	10 U
N-NITROSODIPHENYLAMINE	10 U	10 U		10 U		10 U	10 U
NAPHTHALENE	10 U	10 U		10 U		6 J	1 J
PHENANTHRENE	10 U	10 U		10 U		10 U	10 U
PHENOL	10 U	10 U		10 U		10 U	10 U

PESTICIDES/PCBs (UG/L)

AROCLOR-1016	0.5 U					0.52 U	
AROCLOR-1254	1 U					1 U	
AROCLOR-1260	1 U					1 U	

INORGANICS (UG/L)

ALUMINUM	30.0 U	133 U	57.0 U	64.8 U	46.3 U	30.0 U	82.7 U
ANTIMONY	25.0 U	15.0 U	15.0 UJ	12.0 U	12.0 U	25.0 U	15.0 U
ARSENIC	3.0 U	2.4 J	3.0 J	5.0 U	5.0 U	3.0 U	4.1 J
BARIUM	62.9	105	105	41.6	47.2	112	251
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	1.3 R	177	186 J	175	170	1.1 R	124 U
CADMIUM	2.0 U	2.3 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
CALCIUM	24400	36200	36900	29500	30400	34700	49300
CHROMIUM	5.0 U	3.0 UJ	3.0 U	4.7 U	3.0 U	5.0 U	3.0 U
COBALT	5.0 U	4.0 U	4.0 U	4.2 U	3.0 U	5.0 U	4.0 U
COPPER	10.5 J	3.0 U	2.0 U	6.2 U	2.6 U	5.0 U	3.0
IRON	7580	15400	11700	8030	2110	13100	19000
LEAD	2.0 UJ	2.0 U	2.0 UJ	4.6	2.6 J	2.0 UJ	1.0 U
MAGNESIUM	29300	36900	38100	37100	38400	4040	6590
MANGANESE	1030	1350	1340	238	351	412	646
MERCURY	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	011091-2LMW9D	2LGW9D	2LGW9D	2LGW9D-2	2LGW9D-2	010291-2LMW9S	2LGW9S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1
SAMPLE DATE:	01/10/91	03/21/94	03/21/94	07/06/94	07/06/94	01/02/91	01/25/94
LOCATION:	2LMW9D	2LMW9D	2LMW9D	2LMW9D	2LMW9D	2LMW9S	2LMW9S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered
INORGANICS (UG/L)							
NICKEL	23.1 J	10.0 U	11.4 U	7.0 U	7.0 U	22.6 J	16.8
POTASSIUM	11800	16900	17100	15600	15400	4710	7880
SELENIUM	1.5	3.0 U	3.0 UJ	5.0 UJ	5.0 UJ	2.2	3.0 U
SILVER	7.0 U	2.0 UJ	2.5 U	2.0 U	2.0 U	7.0 U	2.0 U
SODIUM	287000	365000	378000	355000	377000	160000	317000
THALLIUM	2.0 U	10.0 UR	10.0 UR	5.0 U	5.0 U	2.0 UR	10.0 UJ
VANADIUM	20.0 U	5.0 U	5.0 U	3.0 U	3.0 U	20.0 U	5.0 U
ZINC	10.2 J	2.0 U	7.3	11.6 U	9.8 U	14.2 J	61.2
RADIONUCLIDES (PCI/L)							
GAMMA SPEC (K40)		ND		ND			
GROSS ALPHA	14.7 +/- 7.30	7 +/- 5.00 J		6 +/- 5.00		0.5 +/- 2.90	
GROSS BETA	18.8 +/- 7.30	22 +/- 9.00 J		18 +/- 9.00		6 +/- 3.80	
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3		260		222			168

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TABLE 6-9

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2LGW9S	2LGW1S-X	2LPW1S	2LPW1S	2LPW1S-1	2LPW1S-1	2LPW1S-2
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	01/25/94	02/04/94	04/04/94	04/04/94	04/28/94	04/28/94	04/28/94
LOCATION:	2LMW9S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE		10 U			10 U		10 U
1,2-DICHLOROETHENE (TOTAL)		10 U			10 U		10 U
4-METHYL-2-PENTANONE		10 U			10 J		9 J
ACETONE		110 U			20 U		16 U
BENZENE		10 U			10 U		10 U
CARBON DISULFIDE		10 U			10 U		10 U
CHLOROBENZENE		10 U			10 U		10 U
CHLOROFORM		10 U			10 U		10 U
ETHYLBENZENE		10 U			3 J		5 J
METHYLENE CHLORIDE		10 U			20		20
TETRACHLOROETHENE		10 U			10 U		10 U
TOLUENE		10 U			2 J		1 J
TRICHLOROETHENE		10 U			10 U		10 U
XYLENES, TOTAL		9 J			11		26

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE		10 U			10 U		
1,2-DICHLOROBENZENE		10 U			10 U		
1,3-DICHLOROBENZENE		10 U			10 U		
1,4-DICHLOROBENZENE		10 U			10 U		
2,4-DICHLOROPHENOL		10 U			10 U		
2,4-DIMETHYLPHENOL		10 U			10 U		
2,4-DINITROTOLUENE		10 U			10 U		
2-CHLOROPHENOL		10 U			10 U		
2-METHYLNAPHTHALENE		10 U			0.8 J		
4-CHLORO-3-METHYLPHENOL		10 U			10 U		
4-METHYLPHENOL		2 J			10 U		
ACENAPHTHENE		10 U			0.6 J		
ANTHRACENE		10 U			10 U		
BENZOIC ACID		50 U			13 J		
BIS(2-ETHYLHEXYL)PHTHALATE		10 U			10 U		
BUTYL BENZYL PHTHALATE		10 U			10 U		

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW9S	2LGW1S-X	2LPW1S	2LPW1S	2LPW1S-1	2LPW1S-1	2LPW1S-2
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	01/25/94	02/04/94	04/04/94	04/04/94	04/28/94	04/28/94	04/28/94
LOCATION:	2LMW9S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE		10 U			0.6 J		
DI-N-BUTYL PHTHALATE		10 U			10 U		
DI-N-OCTYL PHTHALATE		10 UJ			10 U		
DIBENZOFURAN		10 U			0.6 J		
DIETHYL PHTHALATE		1 J			10 U		
FLUORENE		10 U			0.9 J		
N-NITROSODIPHENYLAMINE		10 U			10 U		
NAPHTHALENE		2 J			3 J		
PHENANTHRENE		10 U			1 J		
PHENOL		10 U			10 U		

PESTICIDES/PCBs (UG/L)

AROCLOR-1016					0.1 UJ		
AROCLOR-1254					0.1 UJ		
AROCLOR-1260					0.1 UJ		

INORGANICS (UG/L)

ALUMINUM	14.0 U				103 U	50.0 U	
ANTIMONY	15.0 U				13.0 U	13.0 U	
ARSENIC	5.3 J				20.0 UJ	2.4 J	
BARIUM	261				878	780	
BERYLLIUM	1.0 U				1.0 U	1.2 J	
BORON	101 U				686	547	
CADMIUM	2.0 U				3.0 U	3.0 U	
CALCIUM	50200				124000	116000	
CHROMIUM	3.0 U				4.0 U	4.0 U	
COBALT	4.0 U				5.0 U	5.0 U	
COPPER	2.0 U		74.7	28.7	9.8 J	5.3 J	
IRON	19600				15100	9610	
LEAD	1.0 UJ		17.7	20.6	2.0 UJ	2.0 UJ	
MAGNESIUM	6880				30800	30400	
MANGANESE	655				478	486	
MERCURY	0.2 U				0.2 U	0.2 U	

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LGW9S	2LGW1S-X	2LPW1S	2LPW1S	2LPW1S-1	2LPW1S-1	2LPW1S-2
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	01/25/94	02/04/94	04/04/94	04/04/94	04/28/94	04/28/94	04/28/94
LOCATION:	2LMW9S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered

INORGANICS (UG/L)

NICKEL	11.8		16.2 U	24.3	11.0 U	11.0 U	
POTASSIUM	7950				87300 J	79900 J	
SELENIUM	3.0 UJ				20.0 UJ	2.0 UJ	
SILVER	2.0 U				2.0 U	2.2 U	
SODIUM	332000				7200000	6960000	
THALLIUM	10.0 UJ				10.0 UJ	10.0 UJ	
VANADIUM	5.0 U				4.0 U	4.0 U	
ZINC	42.6 J		132	35.2	35.5	60.8	

TOTAL PETROLEUM HYDROCARBONS (UG/L)

OIL & GREASE					600		
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MISCELLANEOUS PARAMETERS (MG/L)

AMMONIA, AS NITROGEN					10.2		
BIOCHEMICAL OXYGEN DEMAND					4.1		
CHEMICAL OXYGEN DEMAND					900		
HARDNESS as CaCO3					600		
TOTAL ORGANIC CARBON					13.4		
TOTAL PHOSPHORUS					0.11		
TOTAL SUSPENDED SOLIDS					38		

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LPW1S-3	2LPW1S-4	2LPW1S-5	2LPW1S-6	2LPW1S-7	2LPW1S-7	2LPW1S-8
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	04/28/94	04/28/94	04/28/94	04/29/94	04/29/94	04/29/94	05/01/94
LOCATION:	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U	10 U		10 U
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	10 U	10 U		10 U
4-METHYL-2-PENTANONE	3 J	11	7 J	7 J	7 J		7 J
ACETONE	14 U	12 U	10 U	10 U	10 U		10 U
BENZENE	10 U	10 U	10 U	10 U	10 U		10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U		10 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U		10 U
CHLOROFORM	10 U	10 U	10 U	10 U	10 U		10 U
ETHYLBENZENE	6 J	6 J	5 J	5 J	5 J		6 J
METHYLENE CHLORIDE	22	22	10 U	10 U	10 U		10 U
TETRACHLOROETHENE	10 U	10 U	10 U	10 U	10 U		10 U
TOLUENE	2 J	1 J	2 J	2 J	1 J		2 J
TRICHLOROETHENE	10 U	10 U	10 U	10 U	10 U		10 U
XYLENES, TOTAL	30	28	28	30	32		35

SEMIVOLATILES (UG/L)

1,2,4-TRICHLOROBENZENE					10 U		10 U
1,2-DICHLOROBENZENE					10 U		10 U
1,3-DICHLOROBENZENE					10 U		10 U
1,4-DICHLOROBENZENE					10 U		10 U
2,4-DICHLOROPHENOL					10 U		10 U
2,4-DIMETHYLPHENOL					10 U		0.8 J
2,4-DINITROTOLUENE					10 U		10 U
2-CHLOROPHENOL					10 U		10 U
2-METHYLNAPHTHALENE					0.8 J		1 J
4-CHLORO-3-METHYLPHENOL					10 U		10 U
4-METHYLPHENOL					10 U		0.5 J
ACENAPHTHENE					0.5 J		10 U
ANTHRACENE					10 U		10 U
BENZOIC ACID					50 U		50 U
BIS(2-ETHYLHEXYL)PHTHALATE					10 U		10 U
BUTYL BENZYL PHTHALATE					10 U		10 U

TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LPW1S-3	2LPW1S-4	2LPW1S-5	2LPW1S-6	2LPW1S-7	2LPW1S-7	2LPW1S-8
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	04/28/94	04/28/94	04/28/94	04/29/94	04/29/94	04/29/94	05/01/94
LOCATION:	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered

SEMIVOLATILES (UG/L)

CARBAZOLE					10 U		0.5 J
DI-N-BUTYL PHTHALATE					10 U		10 U
DI-N-OCTYL PHTHALATE					10 U		10 U
DIBENZOFURAN					10 U		10 U
DIETHYL PHTHALATE					10 U		10 U
FLUORENE					0.8 J		0.9 J
N-NITROSODIPHENYLAMINE					10 U		10 U
NAPHTHALENE					2 J		3 J
PHENANTHRENE					1 J		1 J
PHENOL					10 U		10 U

PESTICIDES/PCBs (UG/L)

AROCLOR-1016					1 UJ		1 U
AROCLOR-1254					1 UJ		1 U
AROCLOR-1260					1 UJ		1 U

INORGANICS (UG/L)

ALUMINUM					53.2 U	61.0 U	70.1 U
ANTIMONY					13.0 U	13.7 J	13.0 U
ARSENIC					2.8 J	2.0 U	2.0 U
BARIUM					925	884	956
BERYLLIUM					1.0 U	1.2 J	1.3 J
BORON					628	577	486
CADMIUM					3.0 U	3.0 U	3.0 U
CALCIUM					130000	121000	114000
CHROMIUM					4.0 U	4.0 U	7.9 J
COBALT					5.0 U	5.0 U	5.0 U
COPPER					7.9 J	5.0 U	18.8
IRON					14000	13800	11700
LEAD					2.0 UJ	2.0 U	2.0 U
MAGNESIUM					33500	31000	28600
MANGANESE					523	478	409
MERCURY					0.2 U	0.2 U	0.2 U

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LPW1S-3	2LPW1S-4	2LPW1S-5	2LPW1S-6	2LPW1S-7	2LPW1S-7	2LPW1S-8
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	04/28/94	04/28/94	04/28/94	04/29/94	04/29/94	04/29/94	05/01/94
LOCATION:	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S	2LPW1S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered
INORGANICS (UG/L)							
NICKEL					11.0 U	11.0 U	11.0 U
POTASSIUM					97100 J	89300 J	87800 J
SELENIUM					2.0 UJ	2.0 U	20.0 U
SILVER					2.0 U	2.0 U	2.8 U
SODIUM					6530000	6450000	7280000
THALLIUM					10.0 UJ	10.0 U	10.0 U
VANADIUM					4.0 U	4.0 U	4.5 J
ZINC					46.0	15.0	63.8
TOTAL PETROLEUM HYDROCARBONS (UG/L)							
OIL & GREASE					1100		700
MISCELLANEOUS PARAMETERS (MG/L)							
AMMONIA, AS NITROGEN					7.8		6.79
BIOCHEMICAL OXYGEN DEMAND					2 U		3 U
CHEMICAL OXYGEN DEMAND					839		9440
HARDNESS as CaCO ₃					520		510
TOTAL ORGANIC CARBON					8.7		7.2
TOTAL PHOSPHORUS					0.12		0.1 U
TOTAL SUSPENDED SOLIDS					36		33

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TABLE 6-9

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A LANDFILL; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2LPW1S-8						
INVESTIGATION:	PH2-1						
SAMPLE DATE:	05/01/94	//	//	//	//	//	//
LOCATION:	2LPW1S						
SCREEN DEPTH:	Shallow						
FILTERING:	Filtered						

INORGANICS (UG/L)

ALUMINUM	31.5 U						
ANTIMONY	13.0 U						
ARSENIC	2.0 U						
BARIUM	924						
BERYLLIUM	1.0 U						
BORON	475						
CADMIUM	3.0 U						
CALCIUM	115000						
CHROMIUM	4.0 U						
COBALT	5.0 U						
COPPER	5.0 U						
IRON	8640						
LEAD	2.0 U						
MAGNESIUM	28400						
MANGANESE	406						
MERCURY	0.2 U						
NICKEL	11.0 U						
POTASSIUM	87300 J						
SELENIUM	20.0 U						
SILVER	2.0 U						
SODIUM	6420000						
THALLIUM	10.0 U						
VANADIUM	4.0 U						
ZINC	35.3						

TABLE 6-10
SUMMARY OF PHASE I GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Shallow Wells (1)			Deep Wells (2)		
	Frequency of Range	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)						
1,1,2,2-Tetrachloroethane	0/5	-	ND (3)	2/7	1-140	2LGW13D
1,2-Dichloroethene (total)	0/5	-	ND	1/7	1	2LGW13D
Benzene	1/5	9.5	2LGW18S	0/7	-	ND
Chlorobenzene	1/5	180	2LGW18S	0/7	-	ND
Ethylbenzene	2/5	2-115	2LGW18S	0/7	-	ND
Trichloroethene	0/5	-	ND	1/7	10	2LGW13D
Xylenes, total	2/5	2-730	2LGW18S	0/7	-	ND
SEMIVOLATILE ORGANICS (ug/L)						
1,2,4-Trichlorobenzene	1/5	69.5	2LGW18S	0/7	-	ND
1,2-Dichlorobenzene	1/5	12	2LGW18S	0/7	-	ND
1,3-Dichlorobenzene	1/5	29	2LGW18S	0/7	-	ND
1,4-Dichlorobenzene	1/5	119.5	2LGW18S	0/7	-	ND
2,4-Dimethylphenol	1/5	12	2LGW18S	0/7	-	ND
2-Chlorophenol	1/5	4	2LGW18S	0/7	-	ND
2-Methylnaphthalene	1/5	3.5	2LGW18S	0/7	-	ND
4-Methylphenol	2/5	7-18.5	2LGW18S	0/7	-	ND
Benzoic acid	1/5	4	2LGW9S	0/7	-	ND
Bis(2-ethylhexyl)phthalate	1/5	4	2LGW18S	1/7	6	2LGW18D
Diethyl phthalate	1/5	11	2LGW18S	0/7	-	ND
Naphthalene	3/5	3-17.5	2LGW18S	0/7	-	ND
PESTICIDES/PCBs (ug/L)						
Aroclor-1254	1/5	140	2LGW18S	0/7	-	ND
INORGANICS (ug/L)						
Aluminum	2/5	54.3-57.3	2LGW18S	1/7	35.8	2LGW14D
Arsenic	1/5	4.4	2LGW18S	0/7	-	ND
Barium	5/5	18.5-723	2LGW18S	6/7	31-66.3	2LGW18D
Cadmium	2/5	3.8-28.85	2LGW18S	3/7	3.2-44.8	2LGW13D

TABLE 6-10
SUMMARY OF PHASE I GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Shallow Wells (1)			Deep Wells (2)		
	Frequency of Range	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Calcium	5/5	14100-53900	2LGW18S	7/7	13900-36100	2LGW13D
Chromium	1/5	11.5	2LGW7S	0/7	-	ND
Cobalt	2/5	5.3-12.1	2LGW18S	0/7	-	ND
Copper	2/5	4.75-7.1	2LGW8S	5/7	5.4-15.1	2LGW14D
Iron	5/5	8360-192500	2LGW18S	7/7	28.1-36800	2LGW18D
Lead	3/5	3-8.5	2LGW7S	2/7	3.8-4.4	2LGW14D
Magnesium	5/5	2440-66400	2LGW18S	7/7	2120-29300	2LGW9D
Manganese	5/5	280-575	2LGW18S	7/7	57.5-1030	2LGW9D
Nickel	4/5	16.8-29.05	2LGW18S	4/7	18.4-23.1	2LGW9D
Potassium	5/5	1300-47350	2LGW18S	7/7	1420-11800	2LGW9D
Selenium	4/5	1-2.9	2LGW7S	2/7	1-1.5	2LGW9D
Sodium	5/5	10700-782500	2LGW18S	7/7	10600-287000	2LGW9D
Zinc	5/5	10.5-606	2LGW18S	6/7	8.7-18.6	2LGW14D

- 1 Includes samples 2LMW7S, 2LMW8S, 2LMW9S, 2LMW17S, 2LMW18S, and 2LMW19S (field duplicate of 2LMW18S). Duplicate results are averaged and counted as one sample.
- 2 Includes samples 2LMW7D, 2LMW21D (field duplicate of 2LMW7D), 2LMW8D, 2LMW9D, 2LMW13D, 2LMW14D, 2LMW17D, and 2LMW18D. Duplicate results are averaged and counted as one sample.
- 3 ND - Not Detected.

TABLE 6-11
SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection (3)	Concentration Range	Location of Maximum Detection	Frequency of Detection (3)	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
1,1,2,2-Tetrachloroethane	0/17	-	ND (4)	-	-	NA (5)	1/9	52	2LGW13D	-	-	NA
1,2-Dichloroethene (total)	1/17	2	2LGW13S	-	-	NA	1/9	2	2LGW13D	-	-	NA
4-Methyl-2-pentanone	8/17	3-11	2LPW1S	-	-	NA	0/9	-	ND	-	-	NA
Acetone	1/17	10	2LGW9S	-	-	NA	0/9	-	ND	-	-	NA
Benzene	1/17	6	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Carbon disulfide	1/17	1	2LGW9S	-	-	NA	1/9	1	2LGW14D	-	-	NA
Chlorobenzene	1/17	340	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Ethylbenzene	9/17	3-38	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Methylene chloride	4/17	20-22	2LPW1S	-	-	NA	0/9	-	ND	-	-	NA
Toluene	9/17	1-2	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Trichloroethene	0/17	-	ND	-	-	NA	1/9	4	2LGW13D	-	-	NA
Xylenes, total	10/17	9-760	2LGW18S	-	-	NA	1/9	2	2LGW19D	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
1,2,4-Trichlorobenzene	1/12	7	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
1,3-Dichlorobenzene	1/12	7	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
1,4-Dichlorobenzene	1/12	14	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
2,4-Dimethylphenol	1/12	0.8	2LPW1S	-	-	NA	0/9	-	ND	-	-	NA
2,4-Dinitrotoluene	1/12	7	2LGW7S	-	-	NA	0/9	-	ND	-	-	NA
2-Methylnaphthalene	4/12	0.8-6	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
4-Methylphenol	3/12	0.5-6	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Acenaphthene	5/12	0.5-1	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Benzoic acid	4/12	1-14	2LGW18S	-	-	NA	2/9	0.9-2	2LGW18D	-	-	NA
Bis(2-ethylhexyl)phthalate	4/12	1-54	2LGW8S	-	-	NA	0/9	-	ND	-	-	NA
Butyl benzyl phthalate	1/12	1	2LGW8S	-	-	NA	0/9	-	ND	-	-	NA
Carbazole	3/12	0.5-2	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Di-n-butyl phthalate	1/12	1	2LGW9S	-	-	NA	0/9	-	ND	-	-	NA
Di-n-octyl phthalate	0/12	-	ND	-	-	NA	1/9	2	2LGW19D	-	-	NA
Dibenzofuran	1/12	0.6	2LPW1S	-	-	NA	0/9	-	ND	-	-	NA
Diethyl phthalate	3/12	1	2LGW18S	-	-	NA	1/9	0.6	2LGW17D	-	-	NA
Fluorene	5/12	0.8-1	2LGW7S	-	-	NA	0/9	-	ND	-	-	NA
Naphthalene	6/12	1-42	2LGW18S	-	-	NA	0/9	-	ND	-	-	NA
Phenanthrene	3/12	1	2LPW1S	-	-	NA	0/9	-	ND	-	-	NA
Phenol	0/12	-	ND	-	-	NA	3/9	0.7-1	2LGW19D	-	-	NA
PESTICIDES/PCBs (ug/L)												
Aroclor-1260	1/4	710	2LGW18S	-	-	NA	-	-	NA	-	-	NA
INORGANICS (ug/L)												
Aluminum	2/11	124-89300	2LGW13S	0/11	-	ND	5/9	24-3340	2LGW19D	0/9	-	ND
Antimony	0/10	-	ND	3/11	13.7-34.1	2LGW13S	1/9	20.6	2LGW18D	0/9	-	ND
Arsenic	6/11	2.3-19.6	2LGW13S	6/11	2.3-7.3	2LGW13S	7/9	2.4-4.9	2LGW19D	3/9	2.8-3.1	2LGW18D
Barium	11/11	30.8-956	2LPW1S	10/11	29.2-924	2LPW1S	9/9	8.7-281	2LGW19D	8/9	56-220	2LGW20D

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TABLE 6-11
SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection (3)	Concentration Range	Location of Maximum Detection	Frequency of Detection (3)	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Beryllium	2/11	1.3-4.2	2LGW13S	2/11	1.2	2LPW1S	1/9	1.5	2LGW19D	1/9	1.4	2LGW19D
Boron	5/11	52.5-686	2LPW1S	7/11	51.7-751	2LGW7S	2/9	57.8-177	2LGW9D	2/9	57.3-186	2LGW9D
Cadmium	0/11	-	ND	0/11	-	ND	1/9	2.3	2LGW9D	1/9	2.1	2LGW18D
Calcium	11/11	10800-174000	2LGW18S	10/11	19200-161000	2LGW18S	9/9	20100-80300	2LGW19D	9/9	20000-77600	2LGW19D
Chromium	2/11	7.9-142	2LGW13S	0/11	-	ND	1/9	32.5	2LGW19D	0/9	-	ND
Cobalt	1/11	35.5	2LGW13S	1/11	4.5	2LGW7S	1/9	10	2LGW20D	0/9	-	ND
Copper	7/12	2.5-125	2LGW13S	4/12	2.7-28.7	2LPW1S	2/9	5-42.7	2LGW19D	0/9	-	ND
Iron	11/11	55.1-144000	2LGW18S	10/11	46.4-142000	2LGW18S	9/9	5020-62200	2LGW19D	8/9	1090-11700	2LGW9D
Lead	2/12	17.7-51.1	2LGW13S	1/12	20.6	2LPW1S	2/9	2.6-21.6	2LGW19D	0/9	-	ND
Magnesium	11/11	2650-127000	2LGW7S	10/11	4690-127000	2LGW7S	9/9	3010-36900	2LGW9D	9/9	2960-38100	2LGW9D
Manganese	11/11	126-2570	2LGW13S	11/11	9.1-1810	2LGW13S	9/9	92-1360	2LGW14D	9/9	12.1-1350	2LGW14D
Mercury	1/11	0.32	2LGW13S	1/11	0.29	2LGW8S	0/9	-	ND	1/9	0.2	2LGW19D
Nickel	2/12	16.8-79.5	2LGW13S	2/12	11.8-24.3	2LPW1S	2/9	14.6-80.9	2LGW19D	2/9	14-34.9	2LGW19D
Potassium	11/11	2250-97100	2LPW1S	10/11	2220-89300	2LPW1S	8/9	1930-16900	2LGW9D	8/9	1650-17100	2LGW9D
Selenium	0/11	-	ND	0/11	-	ND	0/9	-	ND	1/9	3	2LGW19D
Silver	0/10	-	ND	0/11	-	ND	2/9	2.5-3.5	2LGW19D	0/9	-	ND
Sodium	11/11	15400-7280000	2LPW1S	10/11	17200-6960000	2LPW1S	9/9	12700-365000	2LGW9D	9/9	12300-378000	2LGW9D
Vanadium	3/11	4.5-182	2LGW13S	2/11	5.1-5.8	2LGW8S	0/9	-	ND	1/9	6.3	2LGW14D
Zinc	9/12	2.8-211	2LGW13S	8/12	2.3-68.9	2LGW18S	5/9	2.8-112	2LGW19D	6/9	2.4-19.4	2LGW14D
MISCELLANEOUS												
Ammonia, as nitrogen (mg/L)	3/3	6.79-10.2	2LPW1S	-	-	NA	-	-	NA	-	-	NA
Biochemical oxygen demand (mg/L)	1/3	4.1	2LPW1S	-	-	NA	-	-	NA	-	-	NA
Chemical oxygen demand (mg/L)	3/3	839-9440	2LPW1S	-	-	NA	-	-	NA	-	-	NA
Total organic carbon (mg/L)	3/3	7.2-13.4	2LPW1S	-	-	NA	-	-	NA	-	-	NA
Total phosphorus (mg/L)	2/3	0.11-0.12	2LPW1S	-	-	NA	-	-	NA	-	-	NA
Total suspended solids (mg/L)	3/3	33-38	2LPW1S	-	-	NA	-	-	NA	-	-	NA
Hardness as CaCO3 (mg/L)	9/9	86-1180	2LGW7S	-	-	NA	9/9	72-260	2LGW9D	-	-	NA
Oil & grease (ug/L)	3/3	600-1100	2LPW1S	-	-	NA	-	-	NA	-	-	NA

- 1 Includes samples 2LGW7S, 2LGW8S, 2LGW9S, 2LGW13S, 2LGW17S, 2LGW18S, 2LGW19S, 2LGW20S, 2LGW1-X, 2LPW1S, and 2LPW1S-1 through 2LPW1S-8.
- 2 Includes samples 2LGW7D, 2LGW8D, 2LGW9D, 2LGW13D, 2LGW14D, 2LGW17D, 2LGW18D, 2LGW19D, and 2LGW20D.
- 3 Note that frequencies of detection for shallow wells may be skewed, particularly for volatile organic compounds, since samples 2LPW1S-1 through 2LPW1S-8 were all collected from the same well (2LPW1) during a 4-day pumping test.
- 4 ND - Not Detected.
- 5 NA - Not Analyzed.

TABLE 6-12
SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
1,1,2,2-Tetrachloroethane	0/6	-	ND (3)	-	-	NA (4)	1/8	62	2LGW13D	-	-	NA
1,2-Dichloroethene (total)	0/6	-	ND	-	-	NA	1/8	1	2LGW13D	-	-	NA
4-Methyl-2-pentanone	0/6	-	ND	-	-	NA	1/8	49	2LGW17D	-	-	NA
Benzene	1/6	32	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Carbon disulfide	1/6	3	2LGW7S	-	-	NA	1/8	1	2LGW17D	-	-	NA
Chlorobenzene	1/6	1200	2LGW18S	-	-	NA	1/8	6	2LGW18D	-	-	NA
Chloroform	1/6	16	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Ethylbenzene	1/6	100	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Methylene chloride	1/6	6.5	2LGW20S	-	-	NA	1/8	1	2LGW13D	-	-	NA
Tetrachloroethene	0/6	-	ND	-	-	NA	1/8	3	2LGW13D	-	-	NA
Trichloroethene	0/6	-	ND	-	-	NA	1/8	23	2LGW13D	-	-	NA
Xylenes, total	2/6	2-510	2LGW18S	-	-	NA	1/8	2	2LGW17D	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
1,2,4-Trichlorobenzene	1/6	65	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
1,2-Dichlorobenzene	1/6	8	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
1,3-Dichlorobenzene	1/6	22	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
1,4-Dichlorobenzene	1/6	55	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
2,4-Dichlorophenol	1/6	2	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
2,4-Dimethylphenol	1/6	8	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
2-Chlorophenol	1/6	12	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
2-Methylnaphthalene	1/6	5	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
4-Chloro-3-methylphenol	1/6	8	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
4-Methylphenol	1/6	0.6	2LGW18S	-	-	NA	1/8	6	2LGW17D	-	-	NA
Anthracene	1/6	0.5	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Benzoic acid	1/6	1	2LGW20S	-	-	NA	3/8	0.5-2	2LGW13D	-	-	NA
Bis(2-ethylhexyl)phthalate	2/6	25-62	2LGW7S	-	-	NA	3/8	3-10	2LGW7D	-	-	NA
Butyl benzyl phthalate	0/6	-	ND	-	-	NA	1/8	0.5	2LGW8D	-	-	NA
Carbazole	1/6	0.8	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Di-n-butyl phthalate	1/6	0.6	2LGW18S	-	-	NA	1/8	1	2LGW9D	-	-	NA
Diethyl phthalate	1/6	13	2LGW18S	-	-	NA	1/8	120	2LGW17D	-	-	NA
N-Nitrosodiphenylamine	1/6	1	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Naphthalene	2/6	2-17	2LGW18S	-	-	NA	0/8	-	ND	-	-	NA
Phenol	0/6	-	ND	-	-	NA	1/8	6	2LGW17D	-	-	NA
PESTICIDES/PCBs (ug/L)												
Aroclor-1016	1/1	7.5	2LGW18S	-	-	NA	-	-	NA	-	-	NA
Aroclor-1260	1/1	290	2LGW18S	-	-	NA	-	-	NA	-	-	NA
INORGANICS (ug/L)												
Aluminum	4/6	593-10300	2LGW19S	2/6	12.8-62.5	2LGW18S	4/8	61.3-449	2LGW17D	2/8	15-16.7	2LGW8D
Antimony	0/5	-	ND	0/6	-	ND	0/8	-	ND	1/8	19.4	2LGW8D
Arsenic	3/6	5-37	2LGW7S	2/6	2.5-2.6	2LGW18S	4/8	2.3-7	2LGW17D	1/8	3.6	2LGW7D

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TABLE 6-12
SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Barium	6/6	34.5-564	2LGW18S	5/6	36.8-523	2LGW18S	8/8	9.7-257	2LGW19D	7/8	32.6-265	2LGW19D
Beryllium	1/6	1.1	2LGW7S	0/6	-	ND	0/8	-	ND	0/8	-	ND
Boron	2/6	303-3010	2LGW7S	3/6	44.2-2670	2LGW7S	1/8	175	2LGW9D	4/8	11.8-170	2LGW9D
Cadmium	0/4	-	ND	0/5	-	ND	3/8	1.7-2.7	2LGW13D	0/8	-	ND
Calcium	6/6	19900-143000	2LGW7S	6/6	21300-147000	2LGW7S	8/8	19100-94100	2LGW19D	8/8	19900-97800	2LGW19D
Chromium	5/6	3.2-23.2	2LGW7S	1/6	6.7	2LGW18S	3/8	2.3-5	2LGW20D	1/8	3.9	2LGW18D
Cobalt	2/6	3.95-9.2	2LGW19S	2/6	5.6-14.4	2LGW18S	2/8	3.2-24.8	2LGW20D	0/8	-	ND
Copper	3/5	8-13.3	2LGW7S	2/6	3.8-30.1	2LGW7S	5/8	5.2-11.8	2LGW20D	1/8	4.8	2LGW8D
Iron	6/6	11700-193000	2LGW18S	6/6	96.8-193000	2LGW18S	8/8	5350-83900	2LGW7D	8/8	22.7-42700	2LGW18D
Lead	3/6	9.4-84	2LGW18S	2/6	4.3-6.3	2LGW17S	3/8	3.4-4.6	2LGW9D	1/8	2.6	2LGW9D
Magnesium	6/6	4350-563000	2LGW7S	6/6	4630-451000	2LGW7S	8/8	3020-37100	2LGW9D	8/8	2730-38400	2LGW9D
Manganese	6/6	175-1785	2LGW20S	6/6	36.8-1920	2LGW20S	8/8	189-705	2LGW20D	8/8	39.9-645	2LGW18D
Mercury	1/6	0.32	2LGW18S	0/6	-	ND	1/8	0.36	2LGW17D	0/8	-	ND
Nickel	2/6	9.3-30.8	2LGW18S	2/6	9-24.9	2LGW18S	1/8	13.7	2LGW7D	2/8	3.9-14	2LGW19D
Potassium	6/6	2990-208000	2LGW7S	5/6	3290-172000	2LGW7S	8/8	865-15600	2LGW9D	7/8	1450-15400	2LGW9D
Sodium	6/6	21800-5230000	2LGW7S	6/6	20900-4570000	2LGW7S	8/8	13700-355000	2LGW9D	8/8	12400-377000	2LGW9D
Thallium	1/5	2.85	2LGW20S	1/6	4.15	2LGW20S	1/6	4	2LGW13D	0/8	-	ND
Vanadium	3/6	24.7-47.3	2LGW20S	1/6	2.3	2LGW20S	0/8	-	ND	0/8	-	ND
Zinc	3/6	42.5-218	2LGW18S	2/6	8.1-74	2LGW18S	4/8	7.4-70.6	2LGW20D	4/8	6.5-16	2LGW7D
MISCELLANEOUS PARAMETERS (mg/L)												
Hardness as CaCO ₃	6/6	64-2900	2LGW7S	-	-	NA	8/8	76-304	2LGW19D	-	-	NA

- 1 Includes samples 2LGW7S-2, 2LGW8S-2, 2LGW17S-2, 2LGW18S-2, 2LGW19S-2, 2LGW20S-2, and 2LGW20S-D-2 (field duplicate of 2LGW20S-2). Duplicate sample results are averaged and counted as one sample.
- 2 Includes samples 2LGW7D-2, 2LGW8D-2, 2LGW9D-2, 2LGW13D-2, 2LGW17D-2, 2LGW18D-2, 2LGW19D-2, and 2LGW20D-2.
- 3 ND - Not Detected.
- 4 NA - Not Analyzed.

TABLE 6-13
CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration ⁽¹⁾		
	Surface Soil (mg/kg)	All Soil (mg/kg)	Groundwater (mg/L)
Benzene	NA ⁽²⁾	NA	0.005/0.016
Chlorobenzene	NA	NA	0.036/0.57
Chloroform	NA	NA	0.005/0.013
Methylene chloride	NA	NA	0.007/0.012
1,4-Dichlorobenzene	NA	NA	0.008/0.063
1,1,2,2-Tetrachloroethane	NA	NA	0.010/0.085
Tetrachloroethene	NA	NA	0.004 ⁽³⁾
1,2,4-Trichlorobenzene	NA	NA	0.007/0.047
Trichloroethene	NA	NA	0.006/0.012
Benzo(a)anthracene	NA	1.8/23	NA
Benzo(b)fluoranthene	NA	1.6/15	NA
Benzo(a)pyrene	0.19 ⁽³⁾	1.6/15	NA
Benzo(k)fluoranthene	NA	1.5/14	NA
Bis(2-ethylhexyl)phthalate	NA	NA	0.008/0.023
4-Methylphenol	NA	NA	0.005/0.008
4,4'-DDT	0.19/2.3	0.12/2.3	NA
Aroclors	1.2/12	4.7/110	0.031/0.39
1,2,3,4,7,8-HxCDF	NA	0.00022/0.00031	NA
1,2,3,6,7,8-HxCDF	NA	0.00014/0.00015	NA
Antimony	NA	13.9/134	0.0086/0.0130
Arsenic	2.5	3.9	0.0043/0.0196
Barium	NA	97.1/667	0.473
Beryllium	1.2	0.91/3.9	0.00076/0.0042
Boron	NA	NA	0.180/1.68
Cadmium	1.9/4.7	3.4/12.1	0.0029/0.0162

TABLE 6-13 (Continued)
CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration ⁽¹⁾		
	Surface Soil (mg/kg)	All Soil (mg/kg)	Groundwater (mg/L)
Chromium	NA	32.5/289	0.0119/0.142
Lead	367	915	0.0142
Manganese	212	265/1150	0.996
Mercury	NA	0.27/3.6	NA
Nickel	NA	81.9/1440	0.0256
Vanadium	NA	28.0/138	0.0166/0.182
Thallium	NA	NA	0.0025 ⁽³⁾
Zinc	2140	9850	NA

- 1 UCL if single concentration presented, otherwise average for CTE and maximum for RME. For groundwater, maximum is defined as the highest average concentration in a single well, and the average is defined as the overall average concentration of all well-specific averages.
- 2 NA - Not applicable. Chemical is not a chemical of concern for this medium.
- 3 Maximum. Average exceeds maximum.

TABLE 6-14
ESTIMATED RISKS⁽¹⁾
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Full-Time Employee		Older Child Trespasser		Construction Worker	
	RME ⁽²⁾	CTE ⁽³⁾	RME	CTE	RME	CTE

HAZARD INDEX

Incidental Ingestion of Soil	3.7E-1	1.3E-2	4.9E-1	7.3E-3	1.4E+1	1.3E-1
Dermal Contact with Soil ⁽⁴⁾	8.5E-1	2.0E-2	9.1E-1	9.1E-3	4.0E+0	3.7E-2
Dermal Contact with Groundwater	NA ⁽⁵⁾	NA	NA	NA	8.1E+3	4.3E+2
Cumulative Risk:	1.2E+0	3.3E-2	1.4E+0	1.6E-2	8.2E+3	4.3E+2

INCREMENTAL CANCER RISK

Incidental Ingestion of Soil	7.4E-6	1.5E-7	3.8E-6	4.1E-8	1.3E-5	1.9E-7
Dermal Contact with Soil ⁽⁴⁾	1.2E-5	2.8E-8	5.0E-6	6.4E-9	2.3E-6	1.6E-8
Dermal Contact with Groundwater	NA	NA	NA	NA	9.7E-4	4.0E-5
Cumulative Risk:	1.9E-5	1.8E-7	8.8E-6	4.7E-8	9.9E-4	4.0E-5

- 1 Chemical-specific risks presented in Appendix F.5.
- 2 CTE - Central Tendency Exposure.
- 3 RME - Reasonable Maximum Exposure.
- 4 Quantitative evaluation performed for cadmium, PCBs, and dioxins (if detected).
- 5 NA - Not applicable; exposure route not evaluated for this receptor.

TABLE 6-15
ECOLOGICAL CHEMICALS OF CONCERN
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Terrestrial Vegetation ^(1,2)		Soil Invertebrates		Short-Tailed Shrew		Red-Tailed Hawk	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
Chlorobenzene	NA	NA	NA	NA	X	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	X	NA	NA	NA
Xylenes (Total)	NA	NA	NA	NA	X	X	X	X
4,4'-DDD	NA	NA	NA	NA	X	NA	X	X
4,4'-DDE	NA	NA	NA	NA	X	NA	X	X
4,4'-DDT	NA	NA	NA	NA	X	NA	X	X
Endrin Ketone	NA	NA	NA	NA	X	NA	NA	NA
Aroclor 1254	NA	NA	NA	NA	X	NA	NA	NA
Aroclor 1260	NA	NA	NA	NA	X	X	X	NA
OCDD	NA	NA	NA	NA	X	X	X	X
Aluminum	X	X	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	X	X	NA	NA
Beryllium	NA	NA	NA	NA	X	X	NA	NA
Cadmium	X	NA	NA	NA	X	X	NA	NA
Chromium	X	X	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	X	NA	NA	NA
Copper	X	X	X	X	X	X	NA	NA
Lead	X	X	X	X	X	X	NA	NA
Manganese	NA	NA	NA	NA	X	X	NA	NA
Mercury	X	NA	NA	NA	NA	NA	NA	NA
Nickel	X	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	X	X	NA	NA
Vanadium	X	X	NA	NA	NA	NA	NA	NA
Zinc	X	X	NA	NA	X	X	X	X

Notes 1) NA - Not applicable. Chemical is not chemical of concern for this receptor.
2) X - Chemical of concern for this receptor.

TABLE 6-16

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	1.6E+2
Zinc	4.3E+1
Chromium	1.7E+1
Vanadium	1.2E+1
Copper	7.9E+0
Lead	7.3E+0
Mercury	2.0E+0
Cadmium	1.6E+0
Nickel	1.1E+0

TABLE 6-17

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	1.4E+2
Chromium	1.4E+1
Vanadium	1.1E+1
Zinc	1.1E+1
Lead	1.6E+0
Copper	1.2E+0

TABLE 6-18

HAZARD QUOTIENTS FOR SOIL INVERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Copper	2.7E + 1
Lead	6.2E + 0

TABLE 6-19
HAZARD QUOTIENTS FOR SOIL INVERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Copper	4.2E+0
Lead	1.4E+0

TABLE 6-20

MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	OCDD	7.5E + 6	100.0
	Aroclor-1260	1.3E + 2	0.0
	Xylenes, total	1.1E + 2	0.0
	Beryllium	4.5E + 1	0.0
	All others	1.4E + 2	0.0
	Total Receptor HI	7.5E + 6	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	1.3E + 6	17.7
	Food	6.2E + 6	82.3
	Water	0.0E + 0	0.0
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	OCDD	4.9E + 3	89.1
	4,4'-DDT	5.0E + 2	9.0
	4,4'-DDD	5.0E + 1	0.9
Red-Tailed Hawk	Xylenes, total	2.2E + 1	0.4
	All others	3.2E + 1	0.6
	Total Receptor HI	5.5E + 3	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	1.8E + 3	33.4
	Food	3.7E + 3	66.6
	Water	0.0E + 0	0.0

TABLE 6-21

**MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT**

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	OCDD	6.1E+6	100.0
	Xylenes, total	7.8E+1	0.0
	Barium	6.3E+1	0.0
	Lead	1.0E+1	0.0
	All others	2.3E+1	0.0
	Total Receptor HI	6.1E+6	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	1.1E+6	17.7
	Food	5.0E+6	82.3
	Water	0.0E+0	0.0
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	OCDD	4.0E+3	98.4
	4,4'-DDT	4.1E+1	1.0
	4,4'-DDD	1.2E+1	0.3
Red-Tailed Hawk	4,4'-DDE	6.4E+0	0.2
	All others	5.7E+0	0.1
	Total Receptor HI	4.1E+3	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	1.5E+3	35.9
	Food	2.6E+3	64.1
	Water	0.0E+0	0.0

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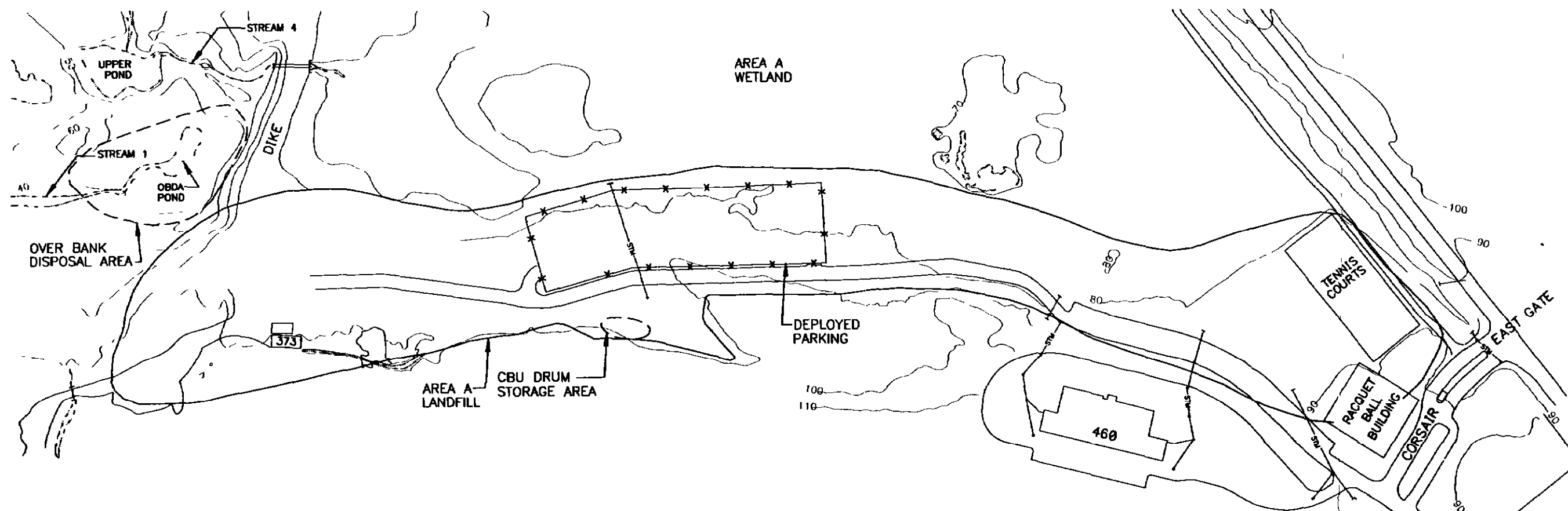


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FIGURE 6-1
GENERAL SITE ARRANGEMENT
AREA A LANDFILL



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NOTE

- 1 BASE MAP AND UTILITY INFORMATION
FROM MAPS OF NSB-NLON AND
PHASE II RI WORK PLAN (ATLANTIC,
MAY 1993)

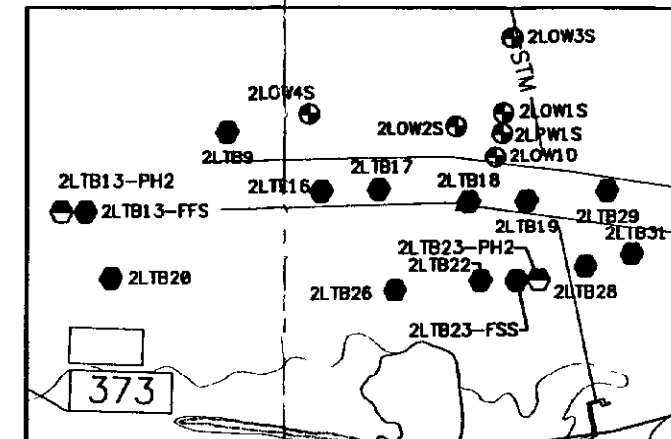
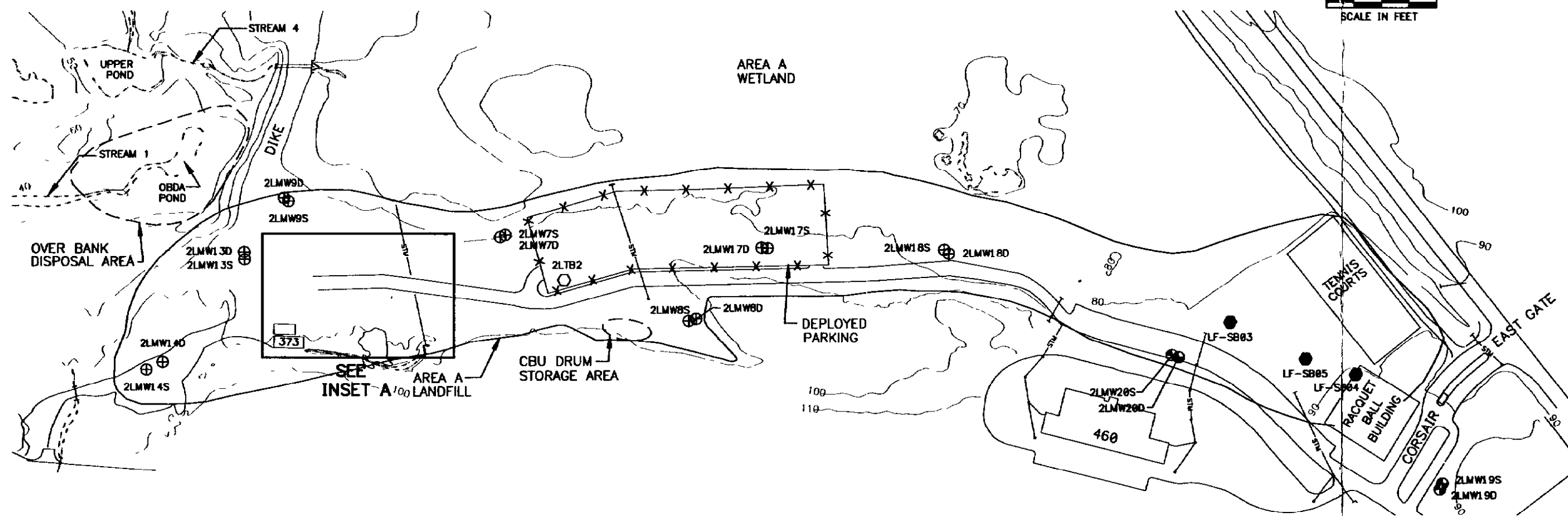


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FIGURE 6-2
TEST BORING AND
WELL LOCATIONS
AREA A LANDFILL



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INSET A

SCALE IN FEET

LEGEND

10	EXISTING CONTOUR
5M	WATERCOURSE
5M	STORM SEWER AND CATCH BASIN
10	EXPOSED BEDROCK
10	FENCE
123	BUILDING NO
2LMW17S	PHASE I MONITORING WELL
2LMW20S	PHASE II MONITORING WELL
2LTB5	PHASE I TEST BORING
2LTB17	FFS TEST BORING
2LTB23-PH2	PHASE II TEST BORING

NOTE

- 1 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
- 2 2LMW14S WAS NOT COMPLETED DUE TO A LACK OF GROUNDWATER A SOIL SAMPLE WAS COLLECTED FROM THIS LOCATION
- 3 THE LOCATION OF 2LTB13-FFS IS APPROXIMATE A BORING WAS DRILLED IN THIS SAME LOCATION DURING BOTH THE FFS AND PHASE II RI
- 4 THE LOCATION OF 2LTB23-FFS IS APPROXIMATE A BORING WAS DRILLED IN THIS SAME LOCATION DURING BOTH THE FFS AND PHASE II RI

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PLOT LIMITS

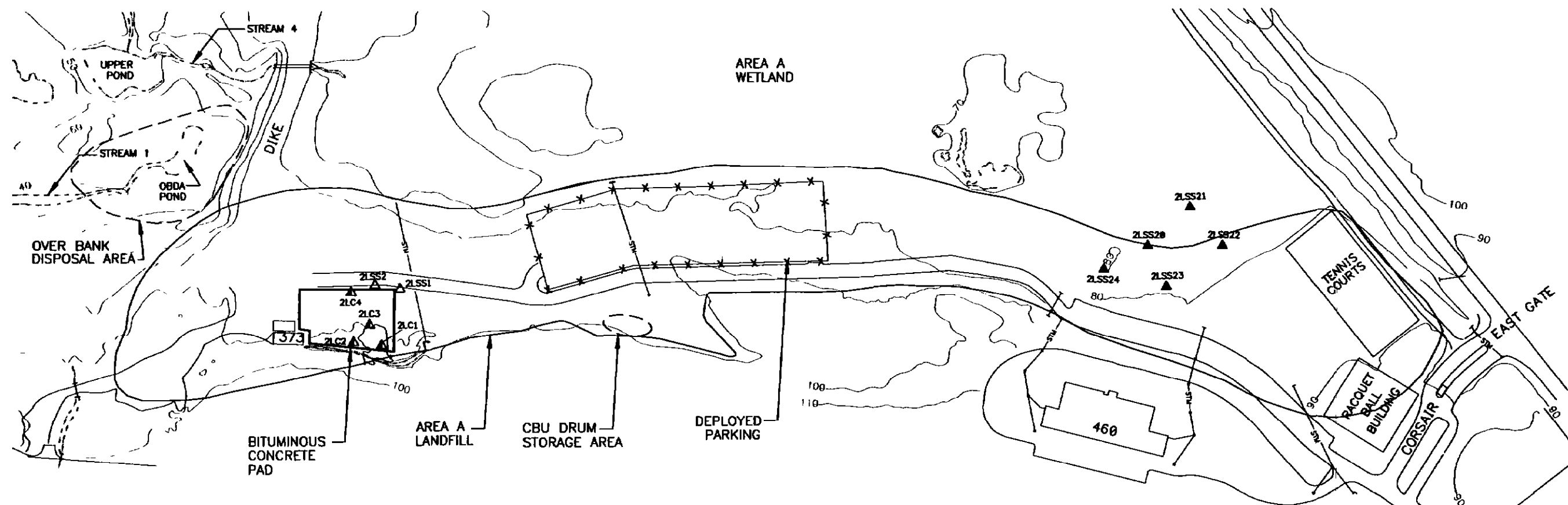


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FIGURE 6-3
SURFACE SAMPLING LOCATIONS
AREA A LANDFILL



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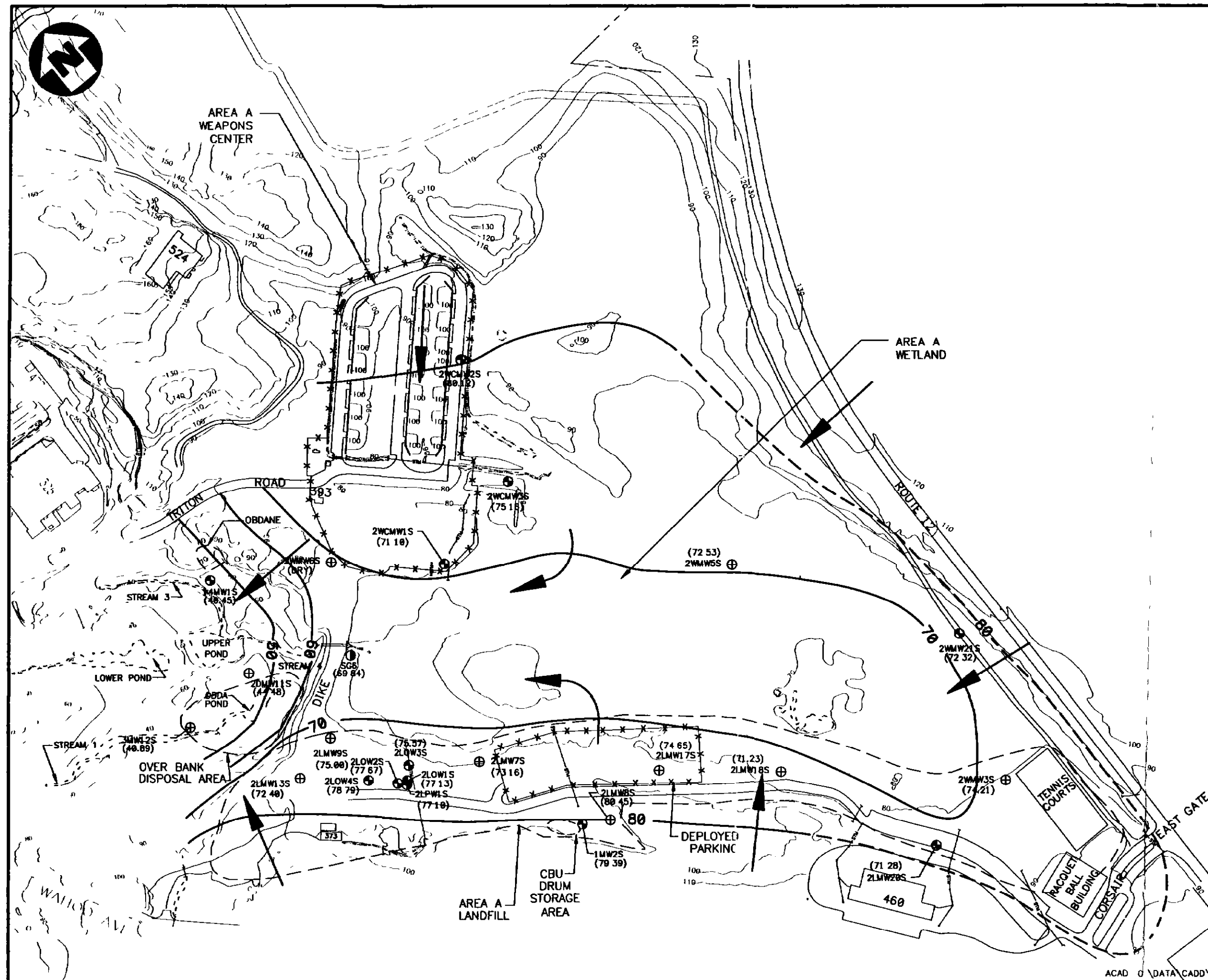


NOTE
1 BASE MAP AND UTILITY INFORMATION
FROM MAPS OF NSB-NLON AND
PHASE II RI WORK PLAN (ATLANTIC,
MAY 1993)

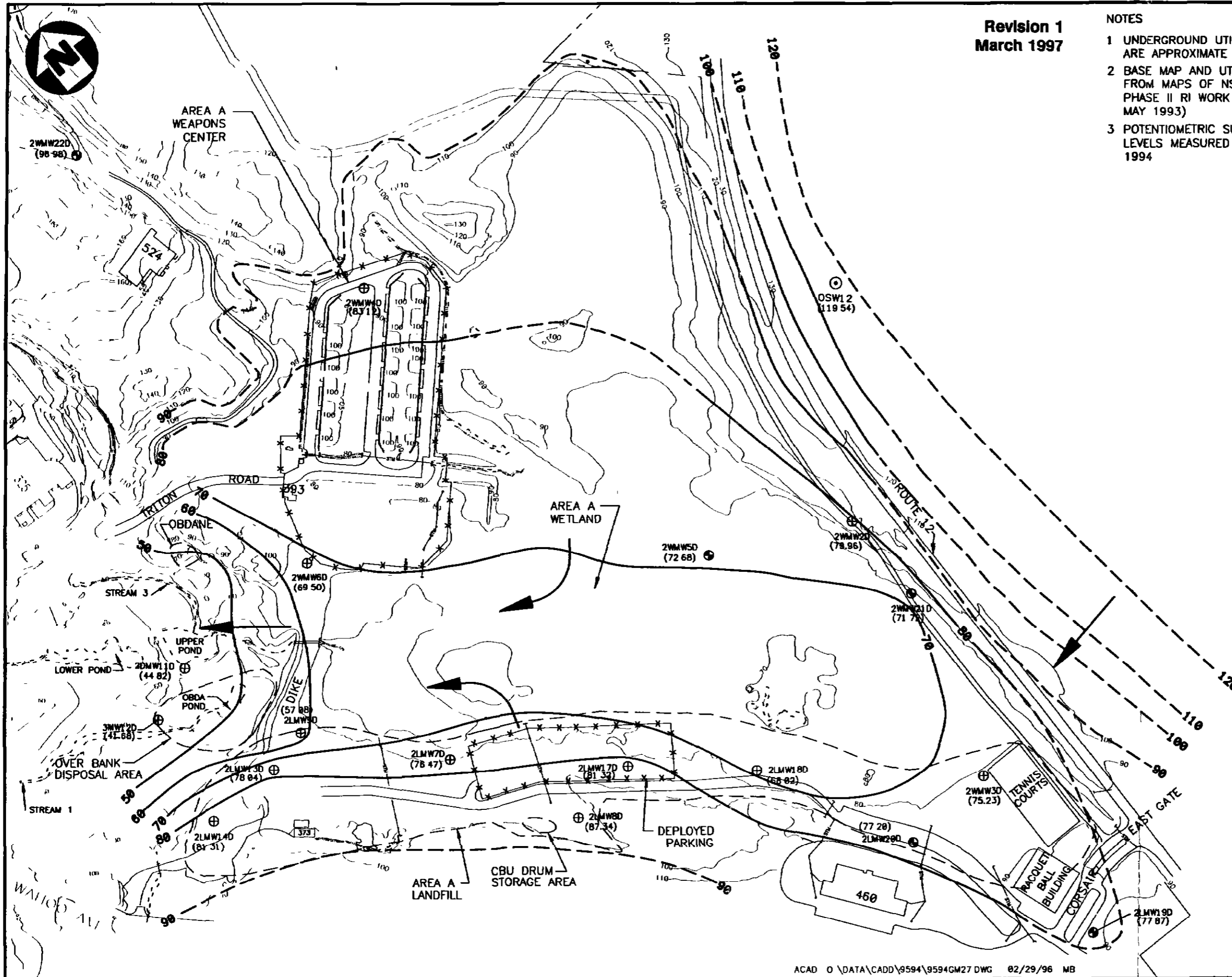
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0108503Z

FIGURE 6-4
SHALLOW OVERBURDEN
POTENTIOMETRIC SURFACE MAP
AREA A LANDFILL,
WETLAND, AND WEAPONS CENTER


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NOTES

- 1 UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE
- 2 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
- 3 POTENTIOMETRIC SURFACE FOR WATER LEVELS MEASURED ON AUGUST 23-24, 1994

FIGURE 6-5

BEDROCK
POTENTIOMETRIC SURFACE MAP
AREA A LANDFILL,
WETLAND, AND WEAPONS CENTER



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LEGEND

- EXISTING CONTOUR
- WATER COURSE
- STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK
- FENCE
- GROUNDWATER FLOW DIRECTION

- PHASE I MONITORING WELL
- PHASE II MONITORING WELL
- RESIDENTIAL WELL
- POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (R MSL)



01085057

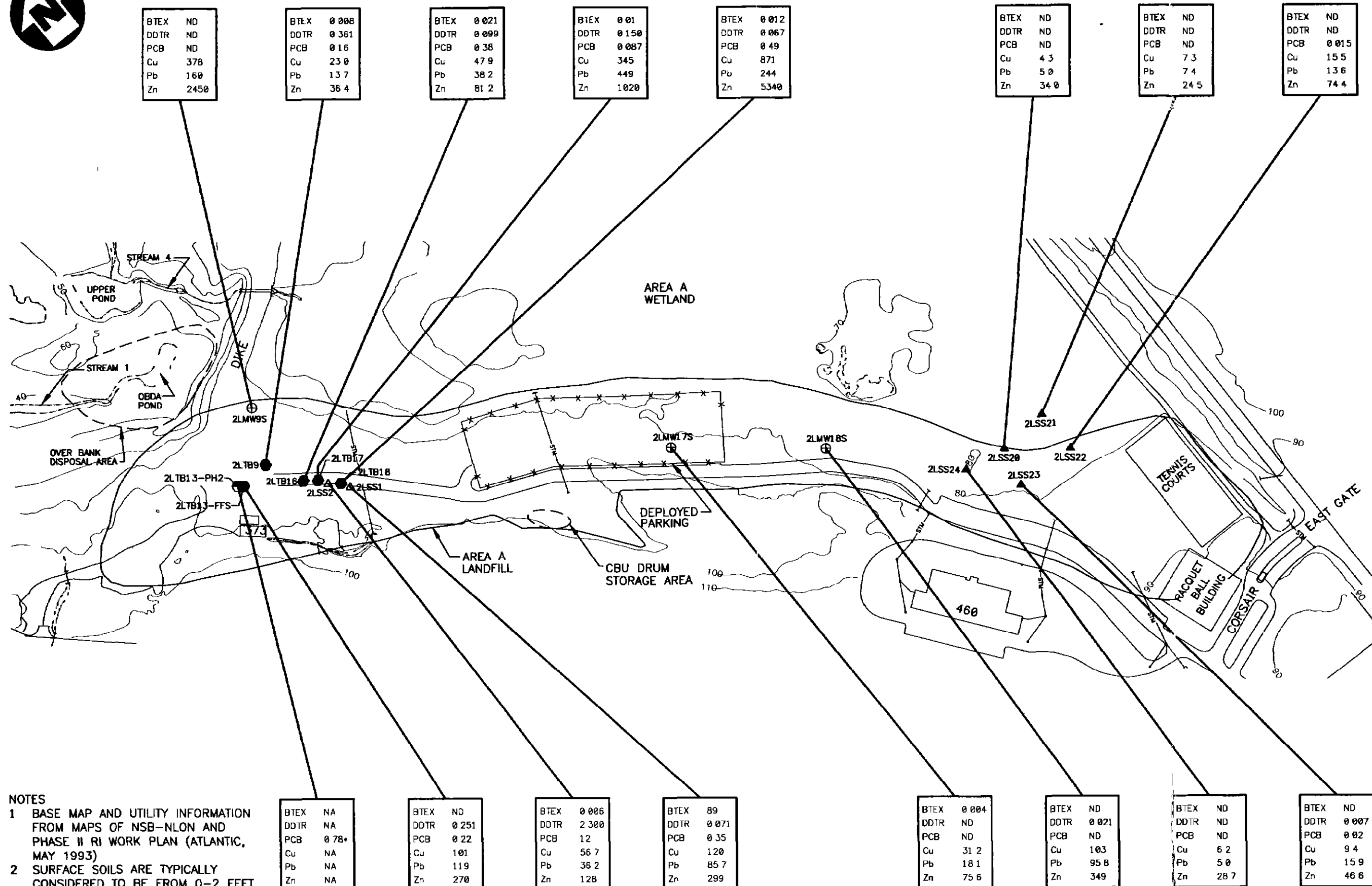


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FIGURE 6-6
BTEX, DDTR, PCBs AND SELECT METALS
IN SURFACE SOILS (mg/kg)
AREA A LANDFILL



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NOTES

- 1 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
- 2 SURFACE SOILS ARE TYPICALLY CONSIDERED TO BE FROM 0-2 FEET FOR THIS FIGURE
- 3 * INDICATES THAT THE RESULT PRESENTED WAS DETERMINED BY FIELD ANALYSIS



(4-8)
BTEX 171.2
CPAH 0.3
NPAH 2.22
DDTR ND
PCB 100
Cu 3900
MA 465
Pb 705
Zn 1650

(6-10)
BTEX 0.027
CPAH 11.2
NPAH 12.7
DDTR 0.053
PCB 0.099
Cu 21600
MA 1150
Pb 1780
Zn 9850

(4-6)
BTEX 0.019
CPAH 12.04
NPAH 20.2
DDTR 0.0138
PCB 0.049
Cu 107
MA 178
Pb 69.8
Zn 190

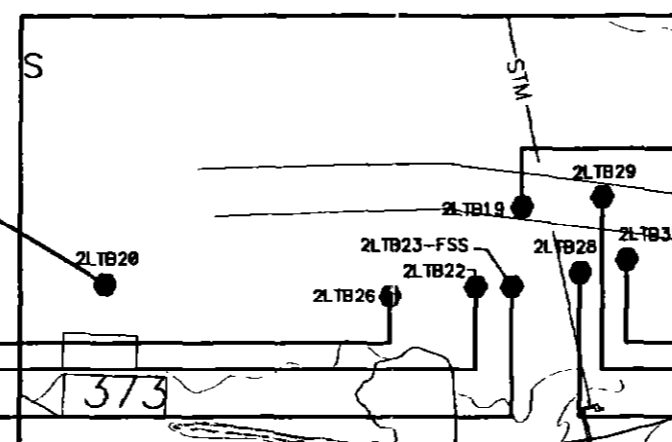
(6-8)
BTEX 16.5
CPAH 86
NPAH 212.4
DDTR 0.047
PCB 0.3
Cu 174
MA 216
Pb 663
Zn 499

(2-4)
BTEX 0.007
CPAH 4.25
NPAH 8.9
DDTR 0.334
PCB 0.92
Cu 815
MA 465
Pb 307
Zn 975

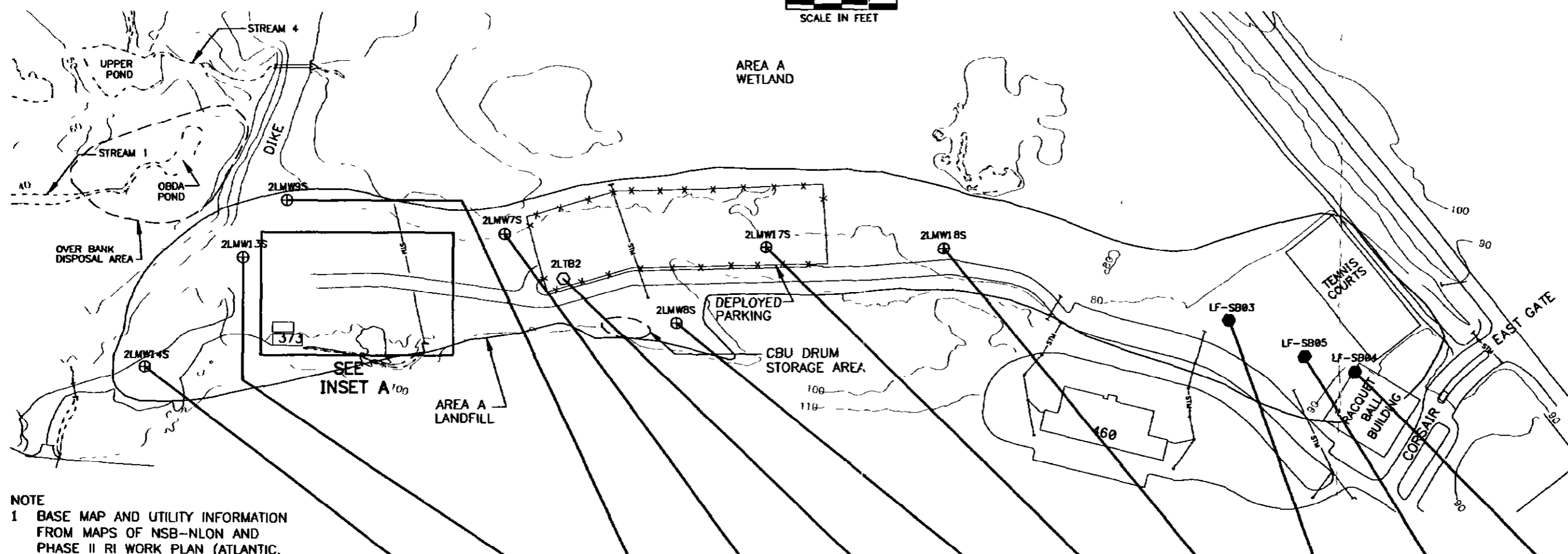
(8-10)
BTEX 0.019
CPAH 2.31
NPAH 1.85
DDTR 1.27
PCB 3.8
Cu 819
MA 1040
Pb 1290
Zn 7570

(10-12)
BTEX 0.012
CPAH 4.28
NPAH 3.07
DDTR 3.78
PCB 0.49
Cu 2830
MA 503
Pb 720
Zn 4030

(4-6)
BTEX 0.013
CPAH 3.65
NPAH 3.22
DDTR 0.76
PCB 10.6
Cu 300
MA 318
Pb 463
Zn 378



INSET A
SCALE IN FEET
0 100



- NOTE
- 1 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
 - 2 2LMW14S WAS NOT COMPLETED DUE TO A LACK OF GROUNDWATER, A SOIL SAMPLE WAS COLLECTED FROM THIS LOCATION
 - 3 THE LOCATION OF 2LTB23-FSS IS APPROXIMATE A BORING WAS DRILLED IN THIS SAME LOCATION DURING BOTH THE FFS AND PHASE II RI
 - 4 IF ANALYTICAL DATA WAS AVAILABLE FROM MULTIPLE SUBSURFACE SAMPLE DEPTHS AT A LOCATION, ONLY THE SAMPLE DEPTH WITH THE MAXIMUM CONCENTRATION IS SHOWN ON THIS FIGURE

(5-7)
BTEX ND
CPAH ND
NPAH ND
DDTR ND
PCB ND
Cu 12.4
MA 74.0
Pb 6.8
Zn 27.5

(6-8)
BTEX ND
CPAH ND
NPAH ND
DDTR ND
PCB ND
Cu 18.2
MA 157
Pb 5.5
Zn 50.0

(2-8)
BTEX ND
CPAH 1.79
NPAH 1.66
DDTR ND
PCB ND
Cu 21.0
MA 241
Pb 114
Zn 902

(7-10)
BTEX ND
CPAH 0.389
NPAH 0.51
DDTR 0.253
PCB ND
Cu 14.1
MA 109
Pb 7.6
Zn 30.0

(2-8)
BTEX 0.764
CPAH ND
NPAH 2.16
DDTR ND
PCB ND
Cu 69.5
MA 149
Pb 170
Zn 149

(6-10)
BTEX 0.011
CPAH 1.39
NPAH 2.623
DDTR 0.19
PCB ND
Cu 30.0
MA 332
Pb 25.3
Zn 229

(4-8)
BTEX 0.229
CPAH ND
NPAH ND
DDTR ND
PCB ND
Cu 45.5
MA 101
Pb 25.3
Zn 93.8

(2-6)
BTEX 0.195
CPAH 1.03
NPAH 3.13
DDTR 0.131
PCB ND
Cu 507
MA 288
Pb 277
Zn 2640

(18.5-20.5)
BTEX ND
CPAH 0.31
NPAH 0.03
DDTR ND
PCB ND
Cu 13.5
MA 326
Pb 8.6
Zn 57.3

(12.5-14.5)
BTEX ND
CPAH ND
NPAH ND
DDTR ND
PCB ND
Cu 13.8
MA 248
Pb 9.6
Zn 38.3

(8-10)
BTEX ND
CPAH ND
NPAH ND
DDTR ND
PCB ND
Cu 13.1
MA 298
Pb 8.1
Zn 47.7

FIGURE B-7
BTEX, PAHs, DDTR, PCBs
AND SELECTED METALS
IN SUBSURFACE SOILS (mg/kg)
AREA A LANDFILL

- LEGEND
- 2LMW17S PHASE I MONITORING WELL
 - 2LMW20S PHASE II MONITORING WELL
 - 2LTB5 PHASE I TEST BORING
 - 2LTB17 FFS TEST BORING
 - 2LTB23-PH2 PHASE II TEST BORING
 - EXISTING CONTOUR
 - WATERCOURSE
 - STORM SEWER
 - CATCH BASIN
 - EXPOSED BEDROCK
 - FENCE
 - BUILDING NO



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7.0 AREA A WETLAND - SITE 2

This section provides a site-specific summary of various aspects of the Area A Wetland investigation. Section 7.1 provides a brief site description. The sampling and analysis program is summarized in Section 7.2. Section 7.3 discusses site physical features. The nature and extent of contamination is discussed in Section 7.4. Contaminant fate and transport is summarized in Section 7.5. Section 7.6 provides the baseline human health risk assessment, Section 7.7 provides the ecological risk assessment and Section 7.8 includes a comparison to state standards. Section 7.9 provides a summary and conclusions.

7.1 SITE DESCRIPTION

The Area A Wetland is adjacent to the northeast edge of the Area A Landfill and is approximately 23.6 acres in size. The Area A Wetland is depicted on Figure 7-1. The location of the Area A Wetland within NSB-NLON is shown on Drawing Number 1 (Volume III). Current photographs of the site are provided in Appendix B.3. This portion of NSB-NLON was undeveloped, wooded land, and possibly wetland, until the late 1950s. In the late 1950s, dredge spoils from the Thames River were pumped to this area and contained within an earthen dike that extends from the Area A Landfill to the south side of the Area A Weapons Center. Based on the boring logs, the total volume of dredged material in the wetlands is approximately 1.2 million cubic yards.

There is a small pond located at the southern portion of the wetland and between one and three feet of standing water is present during all seasons. *Phragmites* is the predominant type of vegetation. Atlantic reported that pesticide "bricks" were placed on the wetland ice during winter and allowed to dissolve as a mosquito control measure. These "bricks" consisted of formulated (water-soluble) DDT and were used in the 1960s, prior to the 1972 ban on DDT.

7.2 SITE INVESTIGATIONS

Section 2.0 included a detailed discussion of the sampling procedures and analytical methods employed during the NSB-NLON Phase I RI. Sample locations (Phase I RI, Phase II RI, and FFS) are depicted on Figures 7-2 and 7-3. The remainder of this section summarizes the scope of the Phase I RI, Phase II RI, and FFS investigations.

7.2.1 Phase I RI

A total of 16 samples plus 4 field duplicates from depths of less than 2 feet (considered to be surface soil/sediment samples) and a total of 25 samples plus one field duplicate from depths greater than 2 feet (considered to be subsurface soil samples) were collected from the Area A Wetland during the Phase I RI. Note that samples collected from depth intervals which began in the 0- to 2-foot range (e.g., 1 to 3 feet) are considered surface soils. These total numbers of sediment/soil samples included the following types of samples. Eight composite sediment samples (2WSD1 through 2WSD8) plus one field duplicate were collected from various onsite areas, and a ninth grab sediment sample (2WSD9) was collected from the drainage culvert coming from the weapons center. The areas where composite samples 2WSD1 through 2WSD4 and 2WSD6 through 2WSD8 were collected were also each evaluated via the installation of a test boring to investigate deeper soils; five surface and 19 subsurface soil samples (plus two surface and one subsurface field duplicates) were collected from the seven test borings in these areas. Additional soil samples (two surface soils plus one field duplicate and six subsurface soils) were collected from four monitoring well borings located throughout the Area A Wetland. The goal of the sampling and analysis program was to assess the nature and extent of potential soil and sediment contamination. All soil/sediment samples collected within the limits of the wetland were at or below the groundwater table. Previous analysis of Area A Wetland sediments indicated the presence of volatile organic compounds, semivolatile organic compounds, pesticides, and metals.

In addition, seven groundwater samples were collected from three shallow wells and four deep wells in the Area A Wetland during the Phase I RI. Two surface water samples (plus one field duplicate) were also collected; one was located near Route 12 and the other was located near the dike outlet. Sample locations are shown on Figures 7-2 and 7-3. Table 7-1 presents a sample-specific summary of the sampling and analysis program for the Phase I RI. Several avian and amphibian ecological samples were also collected during the Phase I RI. Table 7-2 presents a sample-specific summary of ecological sampling performed during the Phase I RI.

7.2.2 Phase II RI

Four new monitoring wells were installed during the Phase II RI, and two rounds of groundwater sampling were completed. Ten samples were collected from four shallow (overburden) and six deep (bedrock) wells during Round 1, and ten samples (including one field duplicate) were collected from three shallow and six deep wells during Round 2. Twenty-nine sediment samples were collected (all samples for GC field screening, and six samples for fixed-base laboratory analysis). A more extensive surface water sampling program was undertaken during Phase II RI to better define the nature and extent of contamination in the

Area A Wetland. In addition to the two Phase I RI sample locations, seven additional surface water samples were collected along Route 12, along the Area A Landfill boundary, and in the northeast portion of the site (east of the Area A Weapons Center). Sample locations are shown on Figures 7-2 and 7-3. Table 7-3 presents a sample-specific summary of the sampling and analysis program for the Phase II RI.

7.2.3 Focused Feasibility Studies (FFSs)

Four sediment samples (2WSD23, 2WSD24, 2WSD25, and 2WSD26) were collected from the southwest portion of the Area A Wetland (along the earthen dike) as part of the Area A Downstream/OBDA FFS. Twenty additional sediment samples were collected from ten transects straddling the Area A Landfill/Area A Wetland boundary as part of the Area A Landfill FFS. Two samples were collected from each transect; one sample was collected from the wetland boundary, and the second was collected approximately 20 feet from the wetland boundary within the wetland area. Sample locations are shown on Figure 7-3. Table 7-4 presents a sample-specific summary of the sampling and analysis programs for the FFSs.

7.3 PHYSICAL CHARACTERISTICS

This section presents a summary of site physical characteristics for the Area A Wetland based on information generated during the Phase I and Phase II RIs. Topography and surface features, surface water, soils, geology, and hydrogeology are discussed in the subsections that follow.

7.3.1 Topography and Surface Features

The Area A Wetland is a relatively flat lying, swampy, vegetated area. Figure 7-1 shows the topography and surface features of the Area A Wetland. In general, the surface elevation of the wetland is between 70 and 80 feet. According to the surficial geology map (USGS, 1960), this area (between Baldwin Hill and the earthen dike) was historically a wetland.

The surface elevation increases to nearly 100 feet in the northeast corner of the wetland. This area was historically a stream valley. After the earthen dike was constructed and the ground surface of the wetland was raised by filling with dredge spoil, groundwater levels rose to the point such that the dredge spoil placed in the northeast corner became saturated.

Several areas within the Area A Wetland are elevated. The most prominent topographic feature is a bedrock knob, located between the Area A Weapons Center and the Area A Landfill. Test boring 2WTB4 confirmed the presence of bedrock within 1 foot of the ground surface at this location. Additionally, the local bedrock

knob is confirmed by the historical surficial geology map, which pre-dates the construction of the earthen dike and filling activities.

7.3.2 Surface Water Features (Atlantic, August 1992)

There is a small pond located at the southeast end of the wetland. Between 1 and 3 feet of standing water is present in the pond during all seasons. Water from the wetland discharges through an earthen dike at the western edge of the wetland via four 24-inch metal culverts to the Area A Downstream Watercourses. These watercourses subsequently discharge into the Thames River. Several shallow intermittent drainage channels cross the wetland.

7.3.3 Soil Characteristics

The SCS Soils Map (SCS, 1983) classifies the soil at the Area A Wetland as Udorthents-Urban land. This soil type is defined as excessively drained to moderately drained soils that have been disturbed by cutting and filling. This is consistent with historical information regarding the placement of dredge spoils in the area. The surface of the Area A Wetland is covered with a 2-foot layer of roots and plant debris derived from *Phragmites*, the predominant vegetation.

7.3.4 Geology

The Area A Wetland is underlain by dredge spoils that consist of silt and clay with traces of fine sand and shell fragments. The makeup of the dredge spoils reflects their original depositional environment, i.e., river bottom sediments. The dredge spoils extend across the present site southeast to 2WMW3 (near the tennis courts) and southwest beneath the Area A Landfill. Dredge spoils are between 25 and 35 feet thick on the south side of the wetland adjacent to the landfill, and 10 to 15 feet thick on the northeast side of the wetland. Where dredge spoil does not lie directly on bedrock, it is underlain by a thin remnant of topsoil, which consists of dark, organic-rich silt, clay, and traces of roots. The topsoil is in turn underlain by alluvial deposits. The bedrock surface across the Area A Wetland is depicted on Drawing 4 (Volume III). Geologic conditions are shown on cross-sections E-E' and F-F' on Drawing 19 and 20, respectively (Volume III).

The alluvial deposits which underlie portions of the Area A Wetland lie between dredge spoil materials/topsoil and bedrock. These deposits consist primarily of sand, with gravel and/or silt, and are significantly more coarse-grained than the overlying dredge spoils. The observed thickness of the alluvium in the Area A Wetland borings ranged from 0 to approximately 36 feet. Since most borings/wells are located along the fringes of the wetland, the presence/thickness of alluvium within the central portion of the alluvium

can only be inferred. Where present, the alluvium was first encountered at elevations typically ranging from 45-50 feet msl in the eastern portion of the wetland and 35-40 feet msl in the western portion near the dike. Based on these observations, the approximate lateral extent of the alluvium in the Area A Wetland can be estimated using the bedrock contours around the wetland, as ranging from the 35 foot msl contour at the dike on the western edge to the 50 foot msl contour along the eastern edge. Areas inside these contours (where the bedrock elevation is lower than the target elevation) are likely to contain some alluvium. Areas where the bedrock surface is higher than these elevations are not likely to contain alluvium. The approximate thickness of the alluvium can also be estimated using the bedrock surface contour map, with the thickness approximated as the difference between the projected (or measured) elevation of the top of the alluvium and the projected (or measured) bedrock surface elevation.

Bedrock beneath the southern portion of the wetland has been identified as the Mamacoke Formation. The northernmost portion of the wetland is underlain by the Granite Gneiss, a gneissic biotite granite. The bedrock surface slopes to the valley occupied by the Area A Wetland from northern, eastern, and central bedrock highs toward the center of the wetland. The lowest bedrock elevation of 8.7 feet was identified at monitoring well location 2WMW3D. There are no data to confirm the bedrock elevation within the center of the wetland. There are two localized bedrock highs. In the northwest central portion of the wetland, the bedrock high corresponds to a topographic high and dry area within the wetland. This topographic high was identified on a historical surficial geology map (USGS, 1960). At the Weapons Center, a remnant bedrock high exists. This bedrock feature is the remnant of past blasting activity that lowered a formerly higher bedrock elevation at this location.

7.3.5 Hydrogeology

Groundwater is present within the overburden and bedrock underlying the Area A Wetland. As is typical for wetland environments, the water table is nearly at the ground surface throughout most of the Area A Wetland. Overburden (both the dredge spoils and alluvium) exists largely under saturated conditions. Due to the finer grained nature of the dredge spoils in comparison to the alluvium, the two units are distinct from a hydrogeologic perspective, but are hydraulically connected. Figure 7-4 shows shallow overburden groundwater contours for the Area A Wetland. Groundwater flow directions in the bedrock mimic the shallow overburden flow pattern (see Figure 7-5). Groundwater flows from higher elevations toward the bedrock valley and ultimately travels to the Area A Downstream Watercourses through a combination of discharge to local streams within the wetland and aquifer underflow. Cross section E-E' shows the groundwater flow directions from the Area A Weapons Center and Rubble Fill Area at Bunker A86 toward the Area A Wetland. Cross-section F-F' shows the groundwater flow direction from the Area A Wetland toward the Area A Downstream Watercourses and the Thames River. Groundwater elevations are similar

in the bedrock and overburden, but the gradient is slightly upward at the 2WMW5 well cluster and slightly downward at the 2WMW21 well cluster. The hydraulic gradient is relatively flat across the Area A Wetland.

The shallow groundwater flow gradient from monitoring well 2WMW3S to Staff Gauge SG-6 is approximately 0.0025 based on the August 1994 water level measurements. Atlantic reported a hydraulic conductivity of 1.0 feet/day (3.5×10^{-4} cm/sec) based on slug testing completed in the dredge spoils. Assuming an effective porosity of 0.30, the estimated groundwater seepage velocity through the dredge spoils is 0.008 ft/day. Based on a hydraulic conductivity of 6.8 feet/day for the alluvium, calculated from a slug test by Atlantic for the Downstream Watercourses area, the alluvium is significantly more permeable than the dredge spoils, and groundwater flow velocities are expected to be higher. Using the same gradient and porosity as was used for the dredge spoils, a flow velocity of 0.06 feet/day for the alluvium was calculated.

7.3.6 Ecological Habitat

The Area A Wetland (23.6 acres) is characterized as a palustrine emergent, nonpersistent, narrow-leaved and broad-leaved deciduous scrub/shrub wetland with a non-tidal artificial water regime. Areas of open water (generally shallow) are scattered across this wetland unit. The soft organic sediments that characterize these wetlands support a monoculture of the reed *Phragmites communis*, which dominates all other vegetative forms. While providing good cover, no species of wildlife is known to utilize this emergent as a source of food. There are scattered patches of open water between the stands of reeds; scattered duckweed (*Lemna spp.*) and filamentous algae found in these areas. As the substrates become firmer, the vegetation becomes more typical of vegetation associated with old fields and upland areas. Those found in the zone of transition include viburnum (*Viburnum recognitum*), spicebush (*Lindera benzoin*), and black alder (*Ilex verticillata*) (Atlantic, 1994c). The dominance of the Area A Wetland by *Phragmites* diminishes the potential quality of this habitat. However, the areas near the Area A Wetland do provide good habitat for ecological receptors that may use the wetlands as a source of drinking water. In addition, the open water areas are known to be utilized by aquatic birds, amphibians, and aquatic insects; amphibians and aquatic insects represent potential prey for wildlife that could forage in this area.

7.4 NATURE AND EXTENT OF CONTAMINATION

This section presents an evaluation of the nature and extent of contamination in the Area A Wetland (Site 2). The discussion includes chemical analytical results from the Phase I and Phase II RIs as well as the FFS. The complete chemical and engineering analytical data base for all samples is contained in Appendix D.3.

7.4.1 Groundwater

Positive analytical results for all groundwater samples are presented in Table 7-5. The results from Phase I and Phase II RI Rounds 1 and 2 are summarized in Tables 7-6 through 7-8.

These tables show that this site exhibits minimal volatile and semivolatile organic groundwater contamination. The only volatile organic detection in samples from the Phase I RI wells occurred in shallow well 2WMW5S (1 $\mu\text{g/L}$ xylenes). In the Phase II RI, carbon disulfide (2 $\mu\text{g/L}$) was detected in the sample from shallow well 2WMW21S. No other volatile organics were detected. Four phthalate esters, three phenols, and benzoic acid were also detected during these sampling events as well. Bis(2-ethylhexyl)phthalate was detected in the Phase I RI ($C_{\text{max}} = 13 \mu\text{g/L}$; deep well 2WMW6D) and the Phase II RI ($C_{\text{max}} = 30.5 \mu\text{g/L}$; average of duplicate results in deep well 2WMW26D). Three additional phthalate esters were detected in samples from Round 1 of the Phase II RI only at concentrations ranging from 0.6 $\mu\text{g/L}$ to 3 $\mu\text{g/L}$. Phenols were detected in deep well 2WMW22D during Round 2 of the Phase II RI at concentrations ranging from 2 $\mu\text{g/L}$ (2-methylphenol) to 14 $\mu\text{g/L}$ (phenol). In addition, no pesticides or PCBs were detected during the Phase I RI.

A majority of the maximum concentrations of metals in shallow and deep Phase I RI groundwater samples were found in samples from wells 2WMW3S and 2WMW3D, respectively. A majority of maximum concentrations detected in shallow wells during both Rounds 1 and 2 of the Phase II RI were found in the samples from well 2WMW21S, which was installed during the Phase II RI. Maximum concentrations of metals in deep wells from the Phase II RI were more widely spread, although samples from wells 2WMW6D and 2WMW3D together contained a majority of the maxima.

Based on the levels of uncertainty reported with results (i.e., uncertainty levels are greater than results) for gross alpha in samples 2WMW3S, 2WMW5S, 2WMW1D and 2WMW6D, and for gross beta in sample 2WMW1D, gross alpha and gross beta are considered as not detected in these samples. With this in mind, gross alpha was detected at 2.8 pCi/L in the sample from shallow well 2WMW6S, and gross beta was detected in shallow well samples at concentrations ranging from 4.4 pCi/L to 40.2 pCi/L. Gross alpha was detected at concentrations ranging from 4.7 pCi/L to 42.2 pCi/L in deep well samples, while gross beta was detected in deep well samples at concentrations ranging from 3.8 pCi/L to 51 pCi/L. Maximum concentrations for gross alpha and gross beta in deep well samples were both found in the sample 2WMW3D.

7.4.2 Surface Water

Positive analytical results for surface water samples are presented in Table 7-9. The analytical results are summarized in Table 7-10.

Diethylphthalate (3.5 $\mu\text{g/L}$ in 2WSW2) was the only organic compound detected in the Phase I RI surface water samples. With the exceptions of cadmium, iron, lead, magnesium, manganese, potassium, and sodium, there was little difference in the metals concentrations between the two samples. Cadmium, iron, lead, and manganese were found at concentrations of 13.7 $\mu\text{g/L}$, 293 $\mu\text{g/L}$, 7.8 $\mu\text{g/L}$, and 52 $\mu\text{g/L}$, respectively, near Route 12 and at concentrations of 66.55 $\mu\text{g/L}$, 3415 $\mu\text{g/L}$, 1.5 $\mu\text{g/L}$, and 131 $\mu\text{g/L}$ at the Area A Wetland outlet. Concentrations of cadmium, iron, and manganese were from two to twelve times higher at the Area A Wetland outlet than at the sampling location near Route 12, while the concentration of lead was approximately five times higher at the sampling location near Route 12.

Based on the levels of uncertainty reported with results (i.e., uncertainty levels are greater than results) for gross alpha in both surface water samples and for gross beta in sample 2WSW2, gross alpha and gross beta are considered as not detected in these samples. With this in mind, gross beta was detected only in sample 2WSW2 (near the Area A Wetland outlet) at a concentration of 8.95 pCi/L.

Tetrachloroethene was the only organic chemical detected in any of the nine surface water samples collected during the Phase II RI. It was detected at a concentration of 2 $\mu\text{g/L}$ in sample 2WSW12, which is adjacent to the Area A Landfill. These analytical results, along with the Phase I RI results, indicate that there is essentially no contamination by organics in the wetland waters. The highest concentrations of many metals were detected in either samples 2WSW1 or 2WSW2. These metals include aluminum, arsenic, barium, boron, copper, magnesium, nickel, potassium, and sodium.

7.4.3 Sediment and Soil

Positive analytical results for sediment and soil samples collected during both the Phase I and Phase II RI, and the FFS are presented on Tables 7-11 and 7-12, respectively. TCLP results for sediments and soils are provided on Tables 7-13 and 7-14, respectively. Results for sediment and soil samples are summarized on Table 7-15.

Several volatile organic chemicals were detected in the soil and sediment samples. These compounds include carbon disulfide, ketones, monocyclic aromatics, and halogenated aliphatics. Acetone, 2-butanone

and carbon disulfide were detected at the greatest concentrations (up to 850 $\mu\text{g/kg}$, 1400 $\mu\text{g/kg}$, and 42 $\mu\text{g/kg}$, respectively). Halogenated aliphatics were detected in as many as six samples at concentrations ranging to 16 $\mu\text{g/kg}$ (tetrachloroethane). Monocyclic aromatics were detected in as many as six samples at concentrations ranging to 14 $\mu\text{g/kg}$. These results are not considered indicative of a major source of volatile organics.

PAHs were the most frequently detected class of compounds in the sediment and soil samples; they were also detected at the highest concentrations. Other semivolatile organics detected include three phthalate esters ranging up to 3,500 $\mu\text{g/kg}$, three phenols (each detected in only one sample) ranging up to 240 $\mu\text{g/kg}$, 1,4-dichlorobenzene (42 $\mu\text{g/kg}$ in T6-B only), benzoic acid (detected at 32,000 $\mu\text{g/kg}$ in sediment sample 2WSD9 and at concentrations less than 800 $\mu\text{g/kg}$ in four other samples), and carbazole (ranging up to 130 $\mu\text{g/kg}$ in six samples).

The concentrations of PAHs were much higher in the sediment and surface soils (less than 2 feet deep) than in the subsurface soils. Total concentrations of carcinogenic and noncarcinogenic PAHs (CPAH and NPAH, respectively) are shown on Figure 7-6 per sample location for samples containing greater than 1,000 $\mu\text{g/kg}$ CPAH or NPAH. The greatest total concentrations of both CPAH (227,000 $\mu\text{g/kg}$) and NPAH (184,400 $\mu\text{g/kg}$) were found in sediment sample 2WSD9, collected from the Area A Weapons Center drainage culvert. With that exception, concentrations of CPAHs and NPAHs were generally highest along the boundary of the Area A Landfill (particularly along the northwestern end of the boundary). Concentrations of CPAH and NPAH in all individual samples collected in the eastern part of the wetland area (i.e., away from the landfill boundary) were less than 1,000 $\mu\text{g/kg}$; only CPAH and NPAH concentrations detected in composite samples from the eastern portion of the wetland exceeded 1,000 $\mu\text{g/kg}$.

Twenty-nine sediment samples were analyzed for 4,4'-DDT and its metabolites and dieldrin using field screening methodologies. No pesticides were detected, at detection limits ranging from approximately 19 $\mu\text{g/kg}$ to 47 $\mu\text{g/kg}$.

Pesticides were detected by the fixed-base laboratory in several sediment samples. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected most frequently (in from 13 to 18 samples) and at the greatest concentrations (ranging from 44 $\mu\text{g/kg}$ to 4800 $\mu\text{g/kg}$). Maximum concentrations of these three pesticides were detected in sediment sample 2WSD25, which is located at the outfall into the Area A Downstream Watercourses. Aroclor-1260 was detected in seven samples, at concentrations ranging from 82 $\mu\text{g/kg}$ to 1500 $\mu\text{g/kg}$. These seven samples included samples collected during the FFS from transects 1, 6, and 7 and surface soil

sample 2WTB2 (0 to 2 feet), all located along the northwest boundary of the landfill. Concentrations of 4,4'-DDT and its breakdown products (identified as DDTR) which are greater than 100 $\mu\text{g/kg}$ as well as all positive concentrations of Aroclor-1260, are shown per sample location in Figure 7-6. Alpha- and gamma-chlordane were also detected in 12 and 11 FFS samples, respectively, but at much lower concentrations ($C_{\text{max}} = 29 \mu\text{g/kg}$). The remaining pesticides were detected in from one to four samples at concentrations of less than 40 $\mu\text{g/kg}$. With the exceptions of 4,4'-DDT and its related pesticides detected in sediment samples 2WSD25 and nearby sample 2WSD24, samples collected from transects 2, 3, 5, and 6 along the northwest boundary of the Area A Landfill generally contained higher concentrations of pesticides than samples collected elsewhere in the Area A Wetland.

Most of the maximum concentrations of metals in the sediment and surface soil samples were also found in samples collected along the northwest boundary of the landfill, primarily in sample T7-B. Maximums for calcium (6800 $\mu\text{g/kg}$), chromium (102 $\mu\text{g/kg}$), silver (4.5 $\mu\text{g/kg}$), and sodium (6650 $\mu\text{g/kg}$), however, were found in surface soil and sediment samples 2WTB8 and 2WSD8, collected from the northeast end of the Area A Wetland. Concentrations of metals detected in subsurface soils were generally similar to those detected in surface soils and sediments, although concentrations of a few metals (barium, boron, copper, iron, selenium, vanadium, and zinc) were more than two times greater in surface samples than in subsurface samples. Maximum detected concentrations of all metals except antimony in surface and subsurface soil samples were above NSB-NLON background levels.

Several metals were detected in the TCLP extracts of the surface and subsurface soil samples. While concentrations of all TCLP metals were less than Federal Toxicity Characteristic regulatory levels, maximum concentrations of chromium, lead, and silver in subsurface samples were above Connecticut remediation standards for pollutant mobility for GB waters.

7.5 CONTAMINANT FATE AND TRANSPORT

The chemical analytical data do not indicate that contaminants are migrating from this area. Rather, the wetland receives runoff from surrounding areas such as Route 12, the Area A Weapons Center, and the Area A Landfill, which probably accounts for the presence of PAHs, pesticides, and some metals in the sediments and soils. The area may also have been affected by the past direct application of pesticides (i.e., DDT "bricks") or by the placement of contaminated dredge spoils. During the Phase I RI, xylenes were detected in a single shallow well (2WMW5S) at a concentration of 1 $\mu\text{g/L}$. These results are not indicative of significant vertical transport of soluble contaminants. A few phthalate esters were detected in the groundwater as were some metals at concentrations that exceed drinking water standards, however, since

they are not typically soluble, their presence may be related to the presence of suspended sediment in the samples. Therefore, little contaminant transport appears to be occurring at this site.

7.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains a summary of the risk assessment conducted for the Area A Wetland. The selection of Chemicals of Concern (COCs) is discussed in Section 7.6.1, and the potential receptors and exposure scenarios are presented in Section 7.6.2. The results of the risk assessment are summarized in Section 7.6.3.

7.6.1 Data Evaluation

COCs in site media were selected using the risk-based COC screening values described in Section 3.3.3. All data collected during Phase I and II RIs and all additional investigations were used to identify COCs, with the exception of composite sediment sample data collected during the Phase I RI (samples 2WSD1 through 2WSD8 for semivolatile organics, pesticides/PCBs, and inorganics), and soil collected from depths greater than 10 feet. Appendix F.6 contains the COC summary screening tables for the site.

Since exposure to soil and sediment at the site is expected to coincide for potential human receptors, soil and sediment data were combined and a single set of COCs was identified for these media. The following chemicals were retained:

- PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene).
- Pesticides (4,4'-DDD and 4,4'-DDT).
- Aroclor-1260.
- Metals (arsenic, beryllium, cadmium, chromium, manganese, and vanadium).

As presented in the site-specific COC summary screening tables (in Appendix F.6), maximum soil/sediment detections were also compared to USEPA SSLs for migration to groundwater. Maximums for several chemicals (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, pentachlorophenol, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, beta-BHC, dieldrin, barium, cadmium, chromium, nickel, and selenium) detected in the soil samples exceeded the SSLs, indicating the potential for these chemicals to migrate to groundwater and potentially impact water quality.

COCs for groundwater were selected using unfiltered and filtered data from shallow and deep wells at the site. This approach results in a conservative list of COCs for groundwater since 1) groundwater at the site is not expected to be used as a potable water supply under potential future land use conditions and 2) dermal contact with shallow groundwater during construction activities is the only anticipated exposure to this medium. The list of COCs for this medium consists of:

- Bis(2-ethylhexyl)phthalate.
- Metals (antimony, arsenic, barium, beryllium, boron, cadmium, lead, manganese, nickel, thallium, and vanadium).

Of these chemicals, maximum detections of bis(2-ethylhexyl)phthalate, arsenic, antimony, cadmium, lead, nickel, and thallium were in excess of primary MCLs. Antimony, which was not detected in the unfiltered samples, was selected as a COC because the concentration of this chemical in filtered sample 2WGW6D exceeded the risk-based screening level.

COCs for surface water at the Area A Wetland include the following chemicals:

- Tetrachloroethene.
- Metals (arsenic, boron, cadmium, manganese, and nickel).

These chemicals were selected based on a comparison of detected concentrations to risk-based COC screening levels for residential tap water ingestion. Maximum concentrations of tetrachloroethene, arsenic, cadmium, and mercury exceeded ambient water quality criteria (for ingestion of water and organisms).

Several organic compounds (acenaphthylene, benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, endrin aldehyde, endrin ketone, endosulfan sulfate, and delta-BHC) and inorganic essential human nutrients (calcium, magnesium, potassium, and sodium) were detected in the site soil samples, but could not be addressed in the quantitative risk assessment because of the absence of published toxicity criteria. In addition, USEPA Region I does not advocate a quantitative evaluation of exposure to aluminum and iron because the only toxicity criteria for these chemicals are provisional reference doses based on allowable daily intakes rather than adverse effect levels. Exposure to these chemicals is discussed in the general uncertainty section of the baseline human health risk assessment.

Exposure concentrations for surface water and groundwater are the average and maximum concentrations (CTE and RME, respectively). Because a sufficient number of soil/sediment samples were collected from the site, UCLs were used as the exposure concentrations for surface soil/sediment and "all soil" (soil from

depths of 0 to 10 feet)/sediment categories. However, in general, if the distribution of a data set was determined to be undefined, average and maximum detections were used. A summary of the COCs and exposure concentrations for each media is provided in Table 7-16.

7.6.2 Exposure Assessment

Exposures to contaminated media at this site are limited to children exploring the general area, although uncontrolled access to the Area A Wetland has been reduced by the installation of a chain-link fence between the wetland and North Lake. It is assumed that these trespassing children would range in age from 6 to 16. Their exposures are assumed to occur between 52 (CTE) and 120 (RME) days/year for a 3-year to 10-year period. These children could be exposed to both sediment/surface soil and surface water via both incidental ingestion and dermal contact. This exposure scenario is considered to be extremely conservative considering the access restrictions in place.

A construction scenario was also evaluated for this site. The construction worker would be exposed to "all soil" (soil from depths of 0 to 10 feet)/sediment via incidental ingestion and dermal contact and groundwater via dermal contact. Exposures are anticipated to occur between 80 (CTE) to 120 (RME) days/year during the entire length of the construction project, which is assumed to be 1 year. Additional details regarding all parameters used in the risk assessment exposure scenarios were presented in Section 3.3.3.

In addition, both the older child trespasser and the construction worker could also be exposed to chemicals in soil via inhalation of fugitive dust and volatile emissions. This exposure pathway is evaluated in a qualitative fashion by a comparison of maximum soil concentrations to USEPA SSLs for the inhalation pathway. This comparison is summarized in the site-specific COC summary screening tables in Appendix F.6. Maximum detections for all soil chemicals were below the inhalation SSLs, indicating that the inhalation pathway is not expected to be a significant exposure route. Consequently, this exposure route was eliminated from further quantitative risk evaluation.

7.6.3 Risk Characterization

A summary of the quantitative risk assessment for the Area A Wetland is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for the RME and CTE scenarios, are outlined in Table 7-17 for the older child trespasser and the construction worker. Sample calculations are provided in Appendix F.3. Appendix F.6 contains the chemical-specific risks for the site.

7.6.3.1 Noncarcinogenic Risks

Cumulative Hazard Indices (HIs) for the older child trespasser and construction worker are less than unity for the CTE. Cumulative HIs for these potential receptors slightly exceed unity for the RME, which indicates that toxic effects may be experienced by these receptors under the defined exposure scenarios.

Although all chemical- and route-specific Hazard Quotients (HQs) for the RME older child trespasser were less than unity, the cumulative HI slightly exceeded unity. Noncarcinogenic hazards for this receptor under the RME are attributed to exposure to cadmium (45 percent), manganese (32 percent), and PCBs (14 percent). To identify whether toxic effects are likely under the RME scenario, a discussion of target organ effects is necessary for those chemicals contributing significantly to the cumulative risks. Chemical-specific HQs are not truly cumulative unless similar target organs or mechanisms of action are observed. Toxicological studies indicate that the primary target organs for exposure to those chemicals contributing the most to the cumulative risk are as follows (the total RME HQ for each chemical is included in parentheses):

- PCBs (0.17) Eyes, fingers, nails
- Cadmium (0.54) Kidney
- Manganese (0.38) . . . Central nervous system

Based on the information presented above, it is unlikely that a total HI for a single target organ would exceed unity. Therefore, no toxic effects are anticipated for the older child trespasser under the RME scenario.

Elevated noncarcinogenic hazards for the construction worker under the RME scenario are primarily attributed to dermal exposure to manganese in groundwater. The chemical-specific HQ for manganese via dermal contact (1.7) slightly exceeds unity.

7.6.3.2 Carcinogenic Risks

For the CTE scenario, cumulative incremental cancer risks for the trespasser and construction worker are less than $1\text{E-}6$. RME cumulative incremental cancer risks for these receptors are within the USEPA's target risk range ($1\text{E-}4$ to $1\text{E-}6$). Incidental ingestion of soil/sediment is the main exposure route of interest. Carcinogenic risks associated with this exposure route are attributed to the detection of several PAHs and arsenic in the site soil/sediment samples. Maximum detected concentrations for PAHs and arsenic were used to calculate risks associated with the RME scenario.

7.6.3.3 Exposure to Lead

Lead was identified as a potential COC for groundwater at the Area A Wetland. The maximum detection of this chemical in groundwater, (32.7 $\mu\text{g/L}$ in unfiltered sample 2WGW2D), exceeded the Federal Action Level of 15 $\mu\text{g/L}$. As discussed in Section 3.3.3, exposure to lead was addressed using the USEPA IEUBK Model. The evaluation was performed for the RME scenario using the RME exposure concentration presented in Table 7-16, along with the maximum detected concentration of lead in soil/sediment samples (298 mg/kg, sample 2WMW6S) and several default parameters (for maternal contribution, dust, diet, etc.). Support documentation for the analysis is provided in Appendix F.6. The estimated geometric mean blood lead level for a child in a residential setting for the RME is 5.4 $\mu\text{g/dL}$. This value is less than the established level of "concern", 10 $\mu\text{g/dL}$. Based on the results of the USEPA IEUBK Model, children exposed site media are not expected to experience toxic effects from exposure to lead in a residential setting.

7.6.3.4 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 3.3.5. Site-specific uncertainties for the risk evaluation for the Area A Wetland are presented below.

Some inorganic chemicals detected in site soil samples may be attributable to naturally occurring background levels. Background levels for metals in soil at NSB-NLON, developed by Atlantic Environmental Services, Inc., were presented in Table 1-2. Reported concentrations of antimony in the site surface soils were below the established background level.

For this risk assessment, construction workers were assumed to come in contact with shallow and deep groundwater during excavation activities. The resulting estimated risks for this exposure route are overestimated to a certain degree since this receptor is more likely to be exposed to shallow groundwater. Several organic compounds (bis(2-ethylhexyl)phthalate, di-n-octylphthalate, phenol, 2-methylphenol, and 4-methylphenol) were detected in the deep wells only. Of these chemicals, only bis(2-ethylhexyl)phthalate was retained as a COC for this medium. This chemical did not contribute significantly to the cumulative risks for the construction worker. Therefore, the impact of the inclusion of shallow and deep groundwater data in assessing risks for the construction worker is considered to be minimal.

7.7 ECOLOGICAL RISK ASSESSMENT

This section contains a site-specific ecological risk assessment for the Area A Wetland. Both maximum and average exposure point concentrations were considered in determining potential risks to ecological receptors. The process followed to determine exposure point concentrations and the methodology used to characterize risks to ecological receptors is summarized in Section 3.4. Detailed calculations are provided in Appendix I.3.

7.7.1 Conceptual Site Model

Samples of surface water, sediment, and surface soils (0 to 2 feet) were collected from the Area A Wetland and analyzed. Additionally, frogs and fledgling catbirds were collected during the Phase I RI investigation and analyzed to determine tissue concentrations of chemicals. Several pathways have been identified for potential exposure to chemicals associated with the Area A Wetland. Ecological receptors utilizing this area are most likely to be exposed to sediment and surface water through direct contact, incidental ingestion while feeding or grooming, and drinking. In addition, receptors may come in contact with contaminants present in surface soils by direct contact with the soil as a results of foraging, movement through the area, or burrowing in the soil (e.g., soil invertebrates).

7.7.2 Exposure Assessment

As discussed in Section 7.3.6, the Area A Wetland is a palustrine emergent, nonpersistent, narrow leaved and broad-leaved deciduous scrub/shrub wetland. *Phragmites communis* dominates the emergent vegetation associated with the wetland. While this emergent provides cover, it does not represent a food source for wildlife and it is unlikely that the Area A Wetland supports as diverse an assemblage of wildlife as that typically associated with these types of habitats. However, the Area A Wetland is surrounded by old field and upland forest vegetation, and the wetlands represent a potential source of drinking water. Aquatic biota inhabiting the Area A Wetland may be exposed to contaminants through direct contact with and ingestion of surface water and sediment and indirectly, through the ingestion of prey. Complete exposure pathways for this site included potential uptake of contaminants by terrestrial vegetation and exposure of soil invertebrates by direct contact with contaminants present in soil moisture or through soil ingestion. Complete exposure pathways for small mammals and aquatic birds included direct contact with contaminated soil or sediments, incidental ingestion of soil and sediments while foraging, ingestion of contaminated drinking water, and consumption of contaminated prey. Predators could be exposed to contaminants at this site by consumption of contaminated prey, ingestion of contaminated drinking water, or incidental ingestion of soil.

7.7.3 Receptor Organisms

While the dominance by *Phragmites* sp. diminishes the quality of this habitat, some of the areas next to the Area A Wetland (e.g., the Area A Downstream Watercourses) are likely to support populations of wildlife receptors. To evaluate potential impacts to wildlife receptors, it was assumed that the Area A Wetland supported a population of benthic invertebrates, that raccoons feed on frogs and drink from the wetland, and that mallards feed on benthic invertebrates (i.e., oligochaetes) and used the wetland as a source of drinking water. Additionally, the wetland was assumed to support a population of soil invertebrates, and small mammals (short-tailed shrews) that inhabited and foraged in the area, preying on soil invertebrates (earthworms). The short tailed shrew served as prey for red-tailed hawks. The same conservative assumptions summarized in Section 3.4.4.2 were retained for this assessment.

7.7.4 Chemicals of Concern

As discussed in Section 7.7.1, surface soils (0 to 2 feet), sediment, and surface water are media with which ecological receptors are likely to come in contact. COCs associated with these contaminated media were selected by comparing exposure point concentrations (both maximum and average values; Appendix I.3) detected in surface soil, sediment, and surface water samples collected from the site to the following (see also Section 3.4.2):

- Inorganics were compared to concentrations of inorganic constituents present in samples collected from NSB-NLON background locations.
- Inorganics present in concentrations greater than background and all organic compounds were compared to conservative benchmark values protective of benthic invertebrates, terrestrial vegetation, soil invertebrates, the raccoon, the mallard, the short-tailed shrew, and the red-tailed hawk. Concentrations of inorganic and organic contaminants in surface water and sediments that exceeded chronic benchmarks were also compared to acute benchmarks.

COCs identified as a result of comparing both the maximum and average concentrations detected in surface water, sediments, and surface soils collected from this area to benchmark values are summarized in Table 7-18.

7.7.5 Risk Characterization

The ecological risk characterization for Site 2 - Area A Wetlands is summarized in this section. Risks to aquatic biota, terrestrial vegetation, soil invertebrates, and terrestrial vertebrates are evaluated. Detailed media- and receptor-specific calculations used to determine ecological risks for this site are contained in Appendix I.3.

7.7.5.1 Aquatic Biota

As discussed in Section 3.4.2.3, potential risks to aquatic biota were determined by comparing concentrations of contaminants detected in surface water to conservative benchmarks for the protection of these receptors. The resulting HQs for aquatic biota at the Area A Wetland are summarized in Tables 7-19 through 7-22.

When the maximum concentrations in surface water were compared to benchmarks protective of aquatic receptors, it was determined that ten inorganics (aluminum, cadmium, barium, zinc, manganese, cobalt, mercury, iron, copper, and lead) were present in concentrations that exceeded their respective background and benchmark values. Of these four metals, aluminum had the greatest HQ value ($2.4E+2$; Table 7-19). These results indicate that, based on exposure to maximum concentrations of inorganics in surface water, aquatic receptors inhabiting the Area A Wetland are potentially at risk. Average chemical concentrations also exceeded benchmark values protective of these receptors Table 7-20 (Appendix I.3), suggesting that it is likely that exposure to surface water in the Area A Wetland is adversely impacting aquatic biota.

When maximum concentrations of inorganics with HQs > 1 were compared to acute surface water benchmarks, eight inorganics exceeded acute benchmarks (Appendix I.3). Average concentrations of four inorganics (aluminum, cadmium, iron, and zinc) exceeded acute benchmarks. HQ values were generally less than those for comparisons to chronic benchmarks.

When the maximum concentrations of inorganics in sediment samples collected from the Area A Wetland were examined, it was determined that arsenic, boron, chromium, copper, cyanide, iron, mercury, and vanadium exceeded background concentrations (Appendix I.3). Of these inorganics, only the maximum concentrations of cyanide ($HQ = 6.1E+1$), copper ($HQ = 4.7E+0$), mercury ($2.2E+0$), chromium ($HQ = 2.0E+0$), and arsenic ($1.5E+0$) exceeded their respective benchmark values (Table 7-21). The maximum concentrations of boron and vanadium also exceeded concentrations detected in background samples. However, no appropriate benchmark values could be determined for these analytes and HQs could not be

calculated. Because the potential risk associated with these metals could not be assessed, both were conservatively retained as potential COCs.

Of the chemicals detected in sediments collected from the Area A Wetland, the maximum concentrations of 13 pesticides exceeded their respective benchmark values. The concentrations of gamma-chlordane and 4,4'-DDD resulted in the highest HQs ($2.3E+2$ and $1.5E+2$, respectively; Table 7-21). These results indicate that benthic organisms exposed to the maximum concentrations of these analytes are potentially at risk. In addition to pesticides, the maximum concentrations of two PAHs (phenanthrene and fluoranthene) detected in Area A Wetland sediments also exceeded their respective benchmark values (Table 7-21). These elevated concentrations of PAHs were detected at sample location 2WSD9 (Figure 7-3). The location of this sample suggests that the Area A Weapons Center may represent the source of PAHs detected in Area A Wetland sediment samples. Although the concentrations of PAHs detected at this location represent a risk to benthic organisms, the results of the screening process determined that the average concentrations of these two organic contaminants did not represent a risk to aquatic biota (Table 7-22). These results indicate that, of the organic contaminants, pesticides detected in sediment samples collected from the Area A Wetland represent the greatest risk to aquatic biota.

When maximum concentrations of inorganics with HQs > 1 were compared to acute sediment benchmarks, only cyanide exceeded its benchmark (Appendix I.3). The same was true for comparisons to average concentrations. For organics, several compounds were COCs after comparisons of maximum concentrations to acute benchmarks; only methoxychlor was a COC for average concentration comparisons to acute benchmarks (Appendix I.3).

Of the metals, only the average concentrations of copper, cyanide, magnesium, and mercury exceeded concentrations present in background sediment samples (Appendix I.3). However, only cyanide, copper, and mercury exceeded its benchmark value. The average concentrations of eight organic compounds also resulted in HQs greater than 1.0 when compared to benchmark values protective of benthic organisms (Table 7-22). These results indicate that the average concentrations of these COCs represent a potential risk to benthic organisms inhabiting the Area A Wetland.

7.7.5.2 Terrestrial Vegetation

As discussed in Section 3.4.2.3, potential risks to terrestrial vegetation were determined by comparing the chemical analytical results to conservative, phytotoxic benchmarks. The benchmark values listed in Will and Suter (1994) are conservative and do not consider site-specific soil characteristics which may affect bioavailability (and their potential toxicity) to plants (Section 3.4.2.3). Maximum and average chemical

concentrations detected in surface soil samples (0 to 2 feet) collected from this site were compared to these phytotoxic benchmark values and HQs were determined. Chemicals associated with the Area A Wetland were considered to represent a risk to terrestrial vegetation if the HQs exceeded 1.0. The HQs determined for terrestrial vegetation at the Area A Wetland are summarized in Tables 7-24 (maximum concentrations) and 7-24 (mean concentrations).

When the maximum concentrations of contaminants detected in Area A Wetland surface soils were compared to phytotoxic benchmark values, nine inorganics with HQs exceeding 1.0 were identified (Table 7-23). The maximum concentrations of aluminum, chromium, and vanadium produced the highest HQs for vegetation ($HQs = 3.6E+2$, $1.0E+2$, and $3.8E+1$; Table 7-23). When average concentrations were compared to phytotoxic benchmarks, HQs decreased somewhat (the HQ for aluminum, chromium, and cadmium equalled $3.0E+2$, $7.0E+1$, and $2.7E+1$ respectively). However, with the exception of selenium, the same chemicals identified as representing a potential risk to vegetation when maximum concentrations were considered still had HQs exceeding 1.0 when average concentrations were used (Table 7-24). Based on this conservative assessment, terrestrial vegetation associated with the Area A Wetland may be adversely impacted as a result of exposure to surface soil.

7.7.5.3 Terrestrial Fauna

Soil Invertebrates

Conservative benchmark values protective of earthworms were used to identify potential risks to soil invertebrates inhabiting the Area A Wetland. The maximum and average concentrations of inorganics detected in surface soil (0 to 2 feet) samples collected from this site were compared to concentrations of constituents present in background samples. Inorganic contaminants present in concentrations greater than background values and all organics were then compared to benchmark values developed for earthworms (see Section 3.4.2.3) and HQs were determined (see Appendix I.3). Chemicals associated with surface soil at the Area A Wetland were considered to represent a risk to terrestrial invertebrates if the HQs exceeded 1.0. These HQs are summarized in Tables 7-25 (maximum concentrations) and 7-26 (average concentrations).

The maximum concentrations of surface soil chemicals were compared to benchmark values developed to be protective of soil invertebrates. The results of this comparison determined that chromium ($HQ = 4.8E+0$), lead ($HQ = 2.2E+0$), and copper ($HQ = 2.1E+0$) were present at concentrations that could adversely impact these receptors (Table 7-25). As summarized in Table 7-26, the average concentrations of chromium ($HQ = 2.8E+0$) and copper ($HQ = 1.4E+0$) exceeded the soil invertebrate benchmark values. As discussed

In Section 3.4.2.3, data regarding the toxicity of soil contaminants to soil invertebrates are limited and difficult to interpret, but the results of this assessment suggest that soil invertebrates exposed to either the maximum concentrations of chromium, lead, and copper, or the average concentrations of chromium and copper present in the Area A Wetland soils are potentially at risk.

Terrestrial Vertebrates

Potential risks to terrestrial ecological receptors coming in contact with chemicals present at the Area A Wetland were assessed by examining risks to the mallard, raccoon, short-tailed shrew and red-tailed hawk. Exposure pathways considered in this assessment for this site included the ingestion of contaminated prey, direct contact with the soil or sediment, incidental ingestion of soil or sediment and ingestion of contaminated drinking water. All calculations performed for representative animals potentially inhabiting the Area A Wetland are contained in Appendix I.3.

As discussed in Section 3.5.3, risks to terrestrial receptors are expressed in terms of HIs, which are the sum of chemical-specific HQs. Tables 7-27 and 7-28 contain the HIs calculated for each receptor exposed to the maximum and average surface soil (0 to 2 feet) chemical concentrations associated with the Area A Wetland.

It was assumed that raccoons and mallards would come in contact with chemicals through the drinking of wetland water and the incidental ingestion of sediments while foraging for food. It was also assumed that raccoons and mallards fed on amphibians (frogs) and benthic invertebrates (oligochaetes), respectively. As noted in Section 7.1.1, frogs were collected and analyzed during the Phase I RI. Tissue concentrations from these analyses (see Appendix I.3) were used to evaluate the potential risks to raccoons resulting from the consumption of prey (frogs) taken from the Area A Wetland.

An HI of $5.6E+2$ was calculated for the mallard when the maximum concentrations of chemicals in surface water and sediment were compared to benchmark values protective of the mallard. These results indicate that this species was potentially at risk (Table 7-27). The pesticides 4,4'-DDD (HQ = $2.8E+2$), 4,4'-DDT (HQ = $1.7E+2$), and heptachlor epoxide (HQ = $4.2E+1$) contributed most significantly to this receptor's potential risk. Ingestion of prey contributed the majority of the risk (82.5%; Table 7-27).

Using of average concentrations of sediment and surface water chemicals to determine the HI for the mallard resulted in lower risks (HI = $9.4E+1$; Table 7-28). The pesticides heptachlor epoxide (HQ = $4.2E+1$), 4,4'-DDD (HQ = $2.9E+1$), 4,4'-DDT (HQ = $1.8E+1$), and 4,4'-DDE (HQ = $4.0E+0$) were the only COCs that presented a potential risk to this receptor (Table 7-28).

Using acute toxicity benchmarks, no HIs > 1 were generated for either the maximum or average exposure scenarios for the mallard, indicating insignificant potential acute risks (Appendix I.3).

When the maximum chemical concentrations in surface water and sediment samples collected from the Area A Wetland were compared to benchmark values protective of the raccoon, an HI of $1.4E+1$ was calculated. This result indicates that this species was potentially at risk (Table 7-26). Vanadium (HQ = $4.2E+0$), heptachlor epoxide (HQ = $2.6E+0$), and phenanthrene (HQ = $1.2E+0$) contributed most significantly to this receptor's potential risk. Incidental ingestion of sediment represented this receptor's primary means of exposure (85.6%; Table 7-27).

Using the average concentrations of sediment and surface water chemicals to determine the HI for this receptor resulted in somewhat lower risks (HI = $8.8E+0$; Table 7-28). Vanadium (HQ = $4.2E+0$), heptachlor epoxide (HQ = $2.2E+0$), and chromium (HQ = $1.1E+0$) were the only compounds that presented a potential risk to this receptor (Table 7-28).

Using acute toxicity benchmarks for the raccoon, no HIs > 1 were generated for either the maximum or average concentration exposure scenarios, indicating insignificant potential acute risks for this receptor (Appendix I.3).

The HI calculated for the short-tailed shrew when the maximum surface soil and surface water concentrations were compared to benchmark values protective of this receptor (HI = $7.7E+2$) indicates that this species was potentially at risk (Table 7-27). Four inorganics (aluminum, vanadium, chromium, and arsenic) contributed most significantly to this receptor's potential risk. Ingestion of prey (39.5%) and incidental ingestion of soil (56.0%) contributed the majority of the risk (Table 7-27).

When it was assumed that this organism was exposed to the average concentrations detected in the Area A Wetland, the resulting HI for this receptor was somewhat lower (HI = $2.8E+2$; Table 7-28) but still indicated that this organism was potentially at risk. Vanadium, chromium, and arsenic were the analytes that made the greatest contribution to this receptor's potential risk (HQ = $1.2E+2$, $6.8E+1$, and $2.5E+1$, respectively; Table 7-28).

When compared to acute toxicity benchmarks, aluminum (HI = $2.3E+1$) and vanadium (HI = $4.7E+1$) were COCs using the maximum contaminant concentrations for the short-tailed shrew (Appendix I.3). For the average exposure scenario, only vanadium (HI = $3.4E+0$) had an HI value in excess of one.

When the maximum concentrations in soil and surface water at the Area A Wetland were compared to conservative benchmark values developed for the red-tailed hawk, an HI of $1.0E+1$ was calculated (Table 7-27). The pesticide, 4,4'-DDD, was the primary contributor to this receptor's risk (46.4%). Aluminum ($HQ = 1.7E+0$) and chromium ($1.3E+0$) were the only other contaminants contributing to this receptor's potential risk (Table 7-27). Ingestion of prey (43.8%) and incidental ingestion of soil (55.4%) represented the primary means of exposure for this receptor.

Comparison of average surface soil and surface water concentrations to the benchmark values developed for the red-tailed hawk resulted in HQs less than 1.0 for aluminum and chromium. The pesticide, 4,4'-DDD, was the sole chemical representing a potential risk to this receptor ($HQ = 1.5E+0$; Table 7-28). The total HI decreased to $4.0E+0$, and ingestion of prey (43.4%) and incidental ingestion of soil (56.1%) remained the primary risk contributors. These results indicate that exposure to the average concentrations detected in surface soils and surface water collected from the Area A Wetland also represents a potential risk to these predators.

Using acute toxicity benchmarks, no HIs > 1 were generated for either the maximum or average exposure scenarios for the red-tailed hawk, indicating insignificant potential acute risks for this receptor (Appendix I.3).

7.7.5.4 Uncertainties

As discussed in Section 3.4, the following conservative assumptions were maintained in performing this ecological risk assessment:

- the site use factor was assumed to equal 100% (i.e., the organisms were assumed to live and forage exclusively within the boundaries of this site),
- minimum body weights were used to calculate receptor dose
- maximum ingestion rates were used to calculate receptor dose
- contaminants were assumed to be 100% biologically available
- the most sensitive life stage was assumed to be exposed to site contaminants
- it was assumed that only contaminated prey were consumed.

By adopting these conservative assumptions, the final risk estimates are deliberately conservative and are likely to overestimate the actual risk associated with contaminants detected at the Area A Wetland. This approach was taken so it may be concluded with confidence that certain chemicals detected at this site are unlikely to represent an ecological risk. While this process serves to significantly reduce the uncertainty associated with eliminating certain chemicals from further consideration, uncertainty is associated with concluding that exposure to the remaining chemicals are adversely impacting ecological receptors. An analysis of the uncertainty associated with the risk assessment process is important in that it identifies, and, to the extent possible, quantifies the uncertainty associated the entire process (problem formulation, data

analysis and risk characterization). The uncertainty introduced into the risk assessment process stems from three sources: 1) imperfect knowledge of things that should be known, 2) systematic errors (e.g., computational, data, or analytical transformation errors), and 3) nonsystematic errors (i.e., random or stochastic errors) and variability in the system being assessed (Solomon et. al, 1996). A detailed discussion of uncertainties associated with the assessment process is contained in Section 3.4. This section focuses on uncertainties and assumptions that should be considered when interpreting the results of the ecological risk assessment performed at the Area A Wetland.

It was conservatively assumed that the Area A Wetland served as the only area in which these representative ecological receptors foraged. The wetland itself encompasses approximately 14 ha. However, the majority of this area is covered by water. Therefore, the portion of the wetland that is actually utilized by the shrew, the raccoon, and the red-tailed hawk (i.e., the drier, un-submerged portion of the wetland) is substantially less than 14 ha. This observation, coupled with the home range of raccoon (39 ha) and the red-tailed hawk (60 - 160 ha) suggests that the actual risks to these two receptors are much less than indicated in Tables 7-27 and 7-28. The shrew would be expected to come into contact with contaminated soils since it is a small terrestrial receptor with a smaller home range than the raccoon and red-tailed hawk. However, its exposure would be confined to the limited areas of unsubmerged soils around the wetland perimeter. The choice of the shrew as a representative for other small is conservative because of its very high metabolic rate, this species expends a great deal of effort foraging for food. Therefore, its contact with and incidental ingestion of soil is greater than that of other small mammals. However, as indicated above, it was also assumed that this receptor exclusively consumed contaminated prey. It is much more likely that the shrew would feed on contaminated and uncontaminated prey, which would reduce its exposure to site contaminants. This assumption therefore results in an overestimation of risk.

Unlike the three receptors discussed above, the mallard could forage over the entire 14 ha wetland area. However, the mallard's home range (540 ha) is much greater than the Area A Wetland. When the size of the homerange is factored into the HI calculations for this species, the resulting HIs are reduced by an order of magnitude. These results suggest that the risks to this receptor are probably much less than those suggested by the original set of HI calculations.

Uncertainty is also associated with characterizing the toxicity of contaminants detected at this site. The ecological risk assessment determined that a number of inorganic contaminants present in surface water samples collected from the Area A Wetland produced HQ values in excess of unity for aquatic biota. The benchmark values used to characterize risks to aquatic biota (e.g., chronic ambient water quality criteria) were deliberately conservative and tend to overestimate risks. For instance, ambient water quality criteria are based on total contaminant concentrations (measurement includes bound and dissolved contaminants)

rather than dissolved (i.e., more biologically available) contaminant concentrations. Furthermore, the ambient water quality criteria for metals and other contaminants are primarily based on the results of laboratory toxicity tests. Metals used in these tests are typically in the form of simple salts that are added to relatively clean (e.g., laboratory grade) water. Contaminants in these laboratory toxicity tests are generally more bioavailable than contaminants present in ambient water that typically contains significant concentrations of binding agents. These laboratory test conditions contribute to the conservative nature of ambient water quality criteria.

In addition to the conservative methods used to generate water quality criteria, the concentrations of two inorganic chemicals measured in surface water samples indicates that the chronic ambient water quality criteria may be too conservative for the Area A Wetland. Specifically, the results of the risk assessment determined that aluminum and barium represented potential contaminants of concern. However, the chronic benchmark value for barium was less than barium concentrations measured in surface water samples collected from all of the reference locations. Like barium, the benchmark value for aluminum was also less than that recorded in samples collected from the pond in Pequot Woods, suggesting that, like barium, the potential risks associated with chronic exposure to this contaminant are actually less than suggested by the HQ value. These results suggest that aquatic organisms inhabiting the Area A Wetland have adapted to these naturally occurring concentrations of aluminum and barium and the potential risks associated with this contaminant are probably less than that indicated by their calculated HQ values.

Conservative benchmark values were also used to assess risks to benthic macroinvertebrates exposed to contaminated sediments. Contaminants resulting in the highest HQ values included gamma chlordane, DDTR, and several other pesticides. The methods used to characterize ecological risks for benthic organisms were those reviewed and approved by USEPA's Science Advisory Board for establishing sediment quality criteria for nonpolar organic chemicals (Equilibrium Partitioning; USEPA, 1993). This method depends on the sediment organic content, chronic ambient water quality criteria, and K_{oc} s. K_{oc} s were calculated from K_{ow} s for these organic contaminants using the regression equation listed in Section 3.4. Therefore, the reliability of the site-specific benchmark value for an organic contaminant depends directly on the reliability of the K_{ow} s for these contaminants. Measured K_{ow} s for most organic chemicals reported in the literature are highly variable - a range of two orders of magnitude is not unusual (USEPA, 1993). Investigations by USEPA have determined that newer methodologies for measuring K_{ow} (i.e., the generator column and the slow stirring methods) appear to produce reproducible, accurate results, whereas values generated using older methods of measurement were highly variable. The K_{ow} s used to calculate the site-specific sediment benchmark values were those reported in Table 3-2 of this report and compiled by USEPA in Appendix IX to 40 CFR Part 264, September, 1992. Uncertainty associated with these values would be reduced if it could be determined whether or not the generator column or slow stirring methods were used to generate

the K_{ow} s used in these calculations. Alternatively, K_{ow} values generated by the USEPA Research Laboratory in Athens, GA and summarized in an unpublished USEPA internal report (USEPA, 1995b) might be used to perform these calculations and reduce the uncertainty associated with these calculations.

In addition to the K_{ow} , the site-specific organic sediment benchmark values also depend on the reliability of the ambient water quality criterion. The Federal and State of Connecticut chronic ambient water quality criteria (CAWQC) for DDTR are the same ($0.001 \mu\text{g/L}$) and were generated using aquatic toxicity data available in 1980 (USEPA, 1980). The CAWQC was used in the calculations performed to predict site-specific benchmark values protective of benthic organisms. This value is not protective not of aquatic biota. It is based on toxicity to sensitive vertebrate (i.e., the brown pelican) receptors. It is possible that this value may be too conservative for aquatic biota, resulting in an overestimation of the actual risks to these receptors.

Finally, it should be noted that the Equilibrium Partitioning Method (EqP) is based on the assumption that the amount of sediment organic carbon, and the bulk sediment organic contaminant concentrations are related. However, EqP assumptions are only approximately true; therefore, predictions based the model are inherently uncertain. This uncertainty reflects the inherent variability in the experimental results used to test the model and the fact that various phenomena have not been accounted for by the model (USEPA, 1993).

While inorganic contaminants were present in excess of conservative benchmark values, no additional data were available to assess the biological availability of these contaminants (i.e., acid volatile sulfide concentrations were not measured). Without these data, it is not possible to determine whether inorganics, rather than organic contaminants, represent a greater potential risk to benthic macroinvertebrates.

The results of the ecological risk assessment demonstrated that several inorganic chemicals present in the surface soil at the Area A Wetland represent a potential risk to terrestrial vegetation. However, the wetland and the area immediately surrounding the wetland supports vegetation (e.g., *Phragmites* sp.). *Phragmites* sp. is well known as an invasive, opportunistic species, tolerant of physically disturbed conditions such as those associated with the Area A Wetlands. However, its presence and the presence of other vegetation, suggests that the chemical contaminants present in the samples collected from this area do not appear to be adversely impacting vegetative growth. As noted in Section 3.0, the benchmark values used to identify vegetative COCs are conservative and do not take into account site-specific variables that govern the bioavailability of soil contaminants to vegetation.

According to the results of the ecological risk assessment, it was determined that aluminum contributed most significantly to the potential risks calculated for terrestrial vegetation. According to Will and Suter (1994), aluminum exerts a toxic response in terrestrial vegetation by interfering with cellular division in roots, decreasing root respiration, binds with phosphorus so that it is not biologically available, interferes with the uptake of essential nutrients (calcium, magnesium, phosphorus) and water, and disrupts enzyme activity. Seedlings are more susceptible to the effects of aluminum toxicity than are older plants (Will and Suter, 1994).

The aluminum benchmark value used to determine if this metal represented a potential risk to terrestrial vegetation was taken from Will and Suter (1994). The benchmark is based on the results of a single study that documented a 30% reduction in white clover seedling establishment when 50 mg/kg aluminum was added to a sandy loam soil with a pH of 5.0. Because only a single study describing the phytotoxicity of aluminum could be identified, the confidence in this benchmark, and therefore the conclusions regarding the potential impacts of aluminum on vegetation within the Area A Wetland, is limited.

The results of the risk assessment determined that chromium, copper, and lead represented a potential risk to soil invertebrates associated with this site. As noted in section 7.7.5.3, copper represents one of a handful of contaminants whose impact on soil invertebrates has been relatively well-documented. The main concern associated with other inorganic soil contaminants is that they may accumulate in soil invertebrates and adversely impact predators. Although the risk assessment indicated that copper, chromium, and lead represented a potential risk to these receptors, additional site-specific data (e.g., soil toxicity tests) are necessary to reduce the uncertainty associated with concluding that these contaminants are biologically available in concentrations that would adversely impact these receptors.

Uncertainty is also associated with the biological availability of soil organic contaminants. None of the soil samples collected from this site were analyzed for TOC. However, a number of the sediment samples were analyzed for this parameter. In the absence of TOC data for surface soils, the average sediment concentration of TOC was used to predict biologically available concentrations of organic contaminants. It is not known if this value over or under represents actual surface soil concentrations of TOC at this site. The use of the sediment TOC value also introduces uncertainty with respect to how well the predicted earthworm BAFs for soil organics represent actual BAFs. TOC is one of the parameters used to calculate earthworm BAFs for organic contaminants.

It was also determined that aluminum was among the contaminants making the greatest contribution to the potential risk calculated for the short-tailed shrew. As summarized in Appendix H, although abundant in food, aluminum is not an essential element for mammals. Aluminum is not readily absorbed through the

skin and gastrointestinal absorption of ingested aluminum is poor due to the transformation of aluminum salts into insoluble aluminum phosphate. The lack of accumulation of aluminum in animals with age or any increase in tissue levels of aluminum following high dietary intake suggests that mammals possess a homeostatic mechanism for this element. This suggests that assumptions that aluminum is 100% bioavailable are too conservative for this element.

The benchmark used to assess the potential risk to small mammals associated with aluminum was derived from toxicity tests performed on female mice. These results are summarized in Opresko et al. (1994). Female mice were exposed to a single dose of aluminum chloride added to drinking water. The tests extended for more than one year, including reproductive stages. The results of the test therefore represent the effects of long term chronic exposure and are consistent with the assumption that exposure to site contaminants is also probably chronic. Growth of the second and third generations was significantly reduced. Therefore, the single dose administered during these tests was regarded as the LOAEL. The LOAEL value was converted to an NOAEL by multiplying by 0.1. The lack of a NOAEL introduces uncertainty to these test results.

The risk assessment determined that vanadium contributed most significantly to the HI calculated for the raccoon (Tables 7-27 and 7-28). Vanadium is the 21st most abundant metal in the earth's crust and is a natural component of fuel oils. In addition, vanadium is commonly employed as an alloying agent by the steel industry and as a catalyst in the chemical industry (Ellenhorn and Barceloux, 1988). Vanadium appears to help regulate the Na^+/K^+ ATPase pump. The physiological mechanism associated with this metal's toxicity is unknown but is believed to be associated with its inhibition of oxidative phosphorylation (Ellenhorn and Barceloux, 1988). Vanadium compounds are poorly absorbed through the gastrointestinal wall. This information indicates that the assumption that 100% of the vanadium consumed by raccoons at the Area A Wetland was absorbed is overly conservative.

As summarized in Table 3-17, the endpoint (NOAEL) used to assess risks to mammals associated with exposure to vanadium was based on a study summarized in Opresko et. al (1994). This study reported the results of a laboratory toxicity test conducted on female rats exposed to three doses of vanadium in the form of metavanadate (41.78% V) administered via oral intubation. This method of administration introduces uncertainty to these test results in that it does not represent a natural means of exposure.

The study performed on the female rats extended through 60 days prior to gestation and through gestation, delivery, and lactation. The results of the test therefore represent the effects of long term chronic exposure and are consistent with the assumption that exposure to site contaminants is also probably chronic. Because significant differences in reproductive effects were observed at all three administered doses, the

lowest dose used in the study was selected as the LOAEL. The resulting LOAEL values were converted to NOAEL values by multiplying by 0.1. The lack of a NOAEL also introduces uncertainty to these test results.

The results of the ecological risk assessment determined that DDTR contributed significantly to the risk of the mallard and red-tailed hawk. DDTR manifests its toxic effect by affecting the nervous system and as a hepatotoxin. Its affect on avian reproduction (i.e., egg shell thinning) is also well known. As summarized in Appendix H, long-term dietary exposure to 2.8 to 3.0 mg/kg (wet weight) results in adverse reproductive effects in mallards, screech owls, and black ducks. When compared to other contaminants, the wildlife toxicity database for DDTR is relatively robust.

For the mallard and red-tailed hawk, the LOAEL for the brown pelican, as reported by Anderson et al. (1975), served as the basis for developing species-specific NOAELs. According to USEPA (1993), this study was deemed most appropriate for the development of avian wildlife criteria for the Great Lakes because: "it represented a peer-reviewed field study that provided a chemical-specific dose-response curve for reproductive success". A UF of $4.00E-2$ was applied to the brown pelican LOAEL ($2.80E-3$ mg/kg/day), resulting in a NOAEL of $1.12E-4$ mg/kg/day for the mallard and red-tailed hawk. As noted by USEPA (1993), piscivorous (fish-eating) birds such as the brown pelican are among the avian species most severely affected by DDTR. Because development of wildlife criteria protective of piscivorous birds was among the goals of the Great Lakes Initiative, use of these data were particularly appropriate. However, neither the mallard nor the red-tailed hawk is piscivorous. Therefore, employing the LOAEL generated for the brown pelican probably results in an overly conservative NOAEL for these two species. The conservatism of this value ($1.12 E-4$ mg/kg/day) is indicated by the LOAELs reported for mallards. LOAELs for this species ranged from 0.58 to 2.91 mg/kg/day (USEPA, 1993). Using a UF of $2.00E-1$ to convert from LOAELs to NOAELs produces mallard NOAELs that range from 0.116 to 0.582 mg/kg/day, significantly greater (less conservative) than the value used to evaluate risks to mallards. While no similar DDTR toxicity data were identified for the red-tailed hawk, results of a study conducted on the American kestrel (LOAEL = 0.39 mg/kg/day; Peakall et. al, 1973) were reported. This species, like the red-tailed hawk, feeds on small mammals, rather than fish. When a UF of $4.00E-2$ is used to account for taxonomic differences between kestrels and owls and to convert from a LOAEL to a NOAEL, a red-tailed hawk NOAEL of $1.56E-2$ mg/kg/day is generated. This value, like those generated for the mallard, are substantially higher (less conservative) than the brown pelican NOAEL used to assess ecological risks to this receptor.

7.8 COMPARISON OF SITE DATA TO CONNECTICUT STANDARDS

Analytical data for the Area A Wetland were compared to Connecticut drinking water standards, remediation standards (CTDEP, January 1996), and Water Quality Standards (1992). Tables summarizing the comparison

of site data to Connecticut standards are provided in Appendix F.6. These tables, which follow the quantitative risk assessment spreadsheets in the cited appendix, identify, on a media-specific basis, those chemicals detected at concentrations in excess of state criteria. Maximum and average chemical concentrations are presented in the summary tables. Although the maximum concentration of a chemical may exceed an associated state criteria, the distribution of the chemical in the medium is also important with respect to decision making. Therefore, the average chemical concentration was included to provide some information on the potential distribution of the chemical. A brief narrative of the findings of this qualitative analysis is provided in the remainder of this section.

Site-specific soil/sediment data were compared to Connecticut remediation standards for direct exposure and pollutant mobility. Based on conversations with the State, USEPA, and Navy (October 25, 1995), an industrial land use scenario is considered to be the most likely exposure scenario for the site. The following chemicals were found at maximum concentrations exceeding the state remediation standard for direct exposure under industrial land use:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Arsenic
- Beryllium
- Chromium

To address concerns regarding migration of chemicals from soil to groundwater, site soil data were compared to Connecticut remediation standards for pollutant mobility. The groundwater classification for the Area A Wetland is GB, which indicates although the State recognizes that groundwater may not meet GA criteria at this time, the goal is to restore groundwater to GA quality. The list of chemicals reported at maximum concentrations exceeding the GB pollutant mobility criteria consists of:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Fluoranthene
- Pyrene
- Dieldrin
- Chromium

- Lead
- Silver

As indicated, TCLP analytical results for several metals exceeded GB pollutant mobility criteria. A qualitative evaluation of the TCLP analytical results for the site soil samples (in relation to state pollutant mobility criteria for inorganics and PCBs) is provided in Table 7-13.

Analytical groundwater data for the site were compared to Connecticut MCLs and remediation standards for groundwater and surface water protection. The following chemicals were detected in the unfiltered groundwater samples at maxima exceeding the state MCLs:

- Bis(2-ethylhexyl)phthalate
- Arsenic
- Cadmium
- Nickel
- Thallium

Exceedances of MCLs were noted for antimony, arsenic, beryllium, cadmium, nickel and thallium in the filtered groundwater samples. In addition, manganese was detected in the unfiltered and filtered samples at maximum concentrations in excess of the 5 mg/L Connecticut Department of Public Health and Addition Services Action Level. Sodium was detected at a maximum concentration of 8,500 mg/L in the unfiltered samples and 8,180 mg/L in the filtered samples. Both of these maxima exceeded the 28 mg/L state Notification Level.

Maximum groundwater concentrations (unfiltered and/or filtered) for the following chemicals exceeded the Connecticut remediation standards for groundwater protection:

- Bis(2-ethylhexyl)phthalate
- Antimony
- Arsenic
- Beryllium
- Cadmium
- Lead
- Nickel
- Thallium

It should be noted that the groundwater protection criteria are applicable for GA or GAA designated groundwater and are also used to protect existing groundwater regardless of the classification.

Since groundwater at the Area A Wetland eventually discharges to a surface water body (i.e., Downstream Watercourses), site-specific groundwater data were also compared to Connecticut remediation standards for surface water protection. Those chemicals found at maxima exceeding the surface water protection criteria are, as follows:

- Arsenic
- Beryllium
- Cadmium
- Lead
- Zinc

For surface water, a qualitative analysis of risk associated with the site data was conducted using Connecticut Water Quality Standards for human health, which are similar to Federal AWQC. The list of chemicals reported at maxima exceeding the state AWQC for the consumption of organisms and/or water and organisms includes:

- Tetrachloroethene
- Arsenic
- Cadmium
- Mercury

7.9 SUMMARY AND CONCLUSIONS

This section presents a summary of major findings of the investigations for the Area A Wetland site. A summary of the nature and extent of contamination is provided in Section 7.9.1. Sections 7.9.2 and 7.9.3 summarize the baseline human health risk assessment and ecological risk assessment for the site, respectively. Section 7.9.4 summarizes the comparison of site data to state standards and Section 7.9.5 provides recommendations regarding additional action or investigatory efforts for the site.

7.9.1 Nature and Extent of Contamination

Various media including surface water, groundwater, sediment, and soil were sampled at the Area A Wetland during the Phase II RI. For the most part, very little evidence of groundwater and surface water

contamination was evident in the samples collected at this site. For example, carbon disulfide ($2\text{ }\mu\text{g/L}$ in one sample) and xylenes ($1\text{ }\mu\text{g/L}$ in one sample) were the only volatile organics detected in groundwater samples. Low concentrations of various semivolatile organics were detected in the groundwater. Bis(2-ethylhexyl)phthalate was detected at the highest concentration ($30.5\text{ }\mu\text{g/L}$). Only one organic chemical (tetrachloroethene) was detected in surface water at the site. This compound was detected in one of nine samples obtained at the site, and the concentration was $2\text{ }\mu\text{g/L}$.

Several volatile organics were detected in the sediment and soil matrices, although most concentrations are also relatively low. The most concentrated volatile organic detected was 2-butanone ($1,400\text{ }\mu\text{g/kg}$). By contrast, relatively high concentrations of various PAHs were found in the sediment and surface soil samples. Concentrations of these analytes ranged as high as $80,000\text{ }\mu\text{g/kg}$ (fluoranthene). Several pesticides and one PCB (Aroclor-1260 at a maximum concentration of $1,500\text{ }\mu\text{g/kg}$) were also detected in the sediment samples. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected most frequently and at the highest concentrations (up to $4,800\text{ }\mu\text{g/kg}$). Chemicals detected at high concentrations in the solid matrices are all considered to be relatively immobile in the environment, as a result of their relatively low solubilities and/or high absorption tendencies.

7.9.2 Baseline Human Health Risk Assessment

The baseline risk assessment for the Area A Wetland focused on an older child trespasser and a construction worker. Exposure to surface water, soil/sediment, and groundwater were considered.

Noncarcinogenic risks (HIs) for the construction worker and older child trespasser under the RME scenario exceeded unity. However, no toxic effects are anticipated for the older child trespasser since chemicals contributing the most to the cumulative risks for this receptor do not impact similar target organs. For the construction worker, manganese (groundwater) contributes significantly to the elevated noncarcinogenic risks. It should be noted that manganese is relatively abundant in the environment.

Lifetime incremental cancer risks for the CTE scenarios for the trespasser and construction worker were less than $1\text{E-}6$, the lower bound of the USEPA target risk range. Lifetime incremental cancer risks exceeded $1\text{E-}6$ for the RME trespasser ($4.2\text{E-}5$) and the RME construction worker ($1.2\text{E-}5$). Primary contributors to the cancer risk estimates for both receptors include PAHs and arsenic.

7.9.3 Ecological Risk Assessment

The Area A Wetland is dominated by the reed *Phragmites communis*. While providing cover, no wildlife species are known to utilize this emergent as a food source. The dominance of the wetland by *Phragmites* diminishes the habitat quality of this area. However, areas near the wetland do provide good habitat for ecological receptors that may forage in the wetlands and use it as a source of drinking water. Organisms utilizing this area may come in contact with surface water, sediments, and soil contaminants associated with the site while searching for food, ingesting water and prey, or burrowing in the soil (e.g., soil invertebrates). Using the conservative assumptions discussed in Section 3.4.4.2, the maximum chemical concentrations in these three media were compared to benchmark values protective of various aquatic and terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact aquatic biota, terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. When the risks associated with the average concentrations were evaluated, risks to these receptors were somewhat reduced but still exceeded 1.0. These results suggest that chemicals detected in surface water, sediment, and surface soil at the Area A Wetland represent a potential risk to both aquatic and terrestrial receptors.

7.9.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 7.8. Fluoranthene, pyrene, and dieldrin in the soil and sediment samples were not retained as COCs in the baseline human health risk assessment, but were reported at maxima in excess of Connecticut remediation standards for pollutant mobility. Although detected concentrations were less than risk-based COC screening levels, these soil/sediment compounds may migrate to groundwater and potentially impact water quality.

For groundwater, sodium was the only chemical which exceeded a state standard, but was not retained as a COC for the human health risk assessment. It should be noted that the applicable state standard for sodium is a Notification Level for a drinking water source and no dose-response parameters are available to quantitatively address exposure to this chemical.

Mercury was the only surface water chemical which exceeded the state AWQC for human health, but was not retained as a COC in the baseline human health risk assessment. The maximum detections of this chemical in unfiltered and filtered surface water samples were less than the risk-based concentration for tap water ingestion and only slightly exceeded the state AWQC for consumption of organisms and/or water and organisms.

7.9.5 Recommendations

It is recommended that the site proceed to a Feasibility Study (FS) to evaluate a "limited action" effort, consisting of a groundwater monitoring program and possibly access/use restrictions. This recommendation for the Area A Wetland is based on the following information:

- Little evidence of surface water or groundwater contamination is present at the site. Only one organic chemical (tetrachloroethene) was detected in surface water at the site. Carbon disulfide (2 $\mu\text{g/L}$ in one sample) and xylenes (1 $\mu\text{g/L}$ in one sample) were the only volatile organics detected in groundwater samples. Low concentrations of semivolatile organic compounds [the highest concentration detected was 30.5 $\mu\text{g/L}$ of bis(2-ethylhexyl)phthalate] were detected in groundwater.
- Although significant concentrations of PAHs, pesticides, and one PCB were detected in soil and sediment samples, these compounds are considered somewhat immobile in the environment. Several volatile organic compounds were detected at relatively low concentrations in the soil and sediment. It is also noted that elevated concentrations of PAHs were detected in sample location 2WSD9. The location of this sample suggests that the Area A Weapons Center may represent the source of contamination. This finding will be discussed further in Chapter 8, Site 20 - Area A Weapons Center.
- The human health risk assessment concluded that carcinogenic risks were less than $1\text{E-}6$ or within the USEPA target risk range of $1\text{E-}6$ to $1\text{E-}4$. Noncarcinogenic risks were below the USEPA acceptable level of one for the CTE. However, the RME construction worker may experience toxic effects since the cumulative HI exceeded one. The human health risk assessment assumed that the construction worker would come in direct contact with soil and groundwater at the site. It is required (per OSHA standards for work on hazardous waste sites) that Health and Safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker to acceptable levels. Furthermore, the majority of the construction worker risk is attributable to the presence of manganese in groundwater which is a commonly detected inorganic.
- The Area A Wetland is dominated by *Phragmites* which does not provide a food source to ecological species. Although the Area A Wetland provides a good habitat for ecological receptors and potential risks exist for aquatic and terrestrial receptors; the calculations were

performed using highly conservative estimates. Furthermore, obvious ecological impacts have not been observed to date.

The exact extent of the "limited action" alternative will be developed during the FS phase of this project. Groundwater monitoring will likely be the major process option in any limited action remedial alternative developed for the Area A Wetland; however, access/use restrictions on certain media at the site may be used to augment monitoring in certain limited action plans. The FS will evaluate "limited action" alternatives (for instance, monitoring with and without access/use restrictions) as well as a "no action" alternative and one or more "active remediation" alternatives. A "limited action" alternative may only be implemented at the Area A Wetland if it compares favorably in the feasibility study to other "no action" and "active remediation" alternatives.

TABLE 7-1

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
SOIL							
2WTB1	8-10	● ⁽⁵⁾	●	●	●	●	
2WTB1	10-12	●	●	●	●	●	
2WTB1	15-17	●	●	●	●	●	
2WTB1	20-22	●	●	●	●	●	
2WTB2	0-2	●	●	●	●	●	
090690-2WTB9 (4-6) ⁽⁶⁾	0-2	●	●	●	●	●	
2WTB2	4-6	●	●	●	●	●	
2WTB2	10-12	●	●	●	●	●	
2WTB2	15-17	●	●	●	●	●	
2WTB2	20-22	●	●	●	●	●	
2WTB3	4-6	●	●	●	●	●	
083190-2WTB9(4-6) ⁽⁷⁾	4-6	●	●	●	●	●	
2WTB3	10-12	●	●	●	●	●	

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TABLE 7-1 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
2WTB3	15-17	●	●	●	●	●	
2WTB3	20-22	●	●	●	●	●	
2WTB4	0-2	●	●	●	●	●	
2WTB6	0-2	●	●	●	●	●	
2WTB6	4-6	●	●	●	●	●	
2WTB6	15-17	●	●	●	●	●	
2WTB6	20-22	●	●	●	●	●	
2WTB7	0-2	●	●	●	●	●	
2WTB7 (25-27) ⁽⁸⁾	0-2	●	●	●	●	●	
2WTB7	4-6	●	●	●	●	●	
2WTB7	10-12	●	●	●	●	●	
2WTB8	1-3	●	●	●	●	●	
2WTB8	6-8	●	●	●	●	●	
2WTB8	10-12	●	●	●	●	●	
2WMW2	0-2	●	●	●	●	●	

TABLE 7-1 (Continued)
 SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
 SITE 2 - AREA A WETLAND
 NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
2WMW3	10-12	●	●	●	●	●	
2WMW3	16-18	●	●	●	●	●	
2WMW5	0-2	●	●	●	●	●	
2WTB11 ⁽⁹⁾	0-2	●	●	●	●	●	
2WMW5	4-6	●	●	●	●	●	
2WMW5	10-12	●	●	●	●	●	
2WMW5	13-13.2	●	●	●	●	●	
2WMW6	2-4	●	●	●	●	●	

SEDIMENT

112690-2WSD1	0-0.5	●	●	●	●	●	
112690-2WSD10 ⁽¹⁰⁾	0-0.5	●	●		●	●	
112690-2WSD2	0-0.5	●	●	●	●	●	
112690-2WSD3	0-0.5	●	●	●	●	●	
112690-2WSD4	0-0.5	●	●	●	●	●	
112690-2WSD5	0-0.5	●	●	●	●	●	

TABLE 7-1 (Continued)
 SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
 SITE 2 - AREA A WETLAND
 NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
112690-2WSD6	0-0.5	●	●	●	●	●	
112690-2WSD7	0-0.5	●	●	●	●	●	
112690-2WSD8	0-0.5	●	●	●	●	●	
112690-2WSD9	0-0.5	●	●	●	●	●	
SURFACE WATER							
121090-2WSW1	--	●	●	●	●		●
121090-2WSW2	--	●	●	●	●		●
121090-2WSW3 ⁽¹¹⁾	--	●	●	●	●		●
GROUNDWATER							
011591-2WMW1D	--	●	●	●	●		●
011491-2WMW2D	--	●	●	●	●		●
121190-2WMW3S	--	●	●	●	●		●
011191-2WMW3D	--	●	●	●	●		●
121490-2WMW5S	--	●	●	●	●		●

TABLE 7-1 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)			TAL ⁽²⁾	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides/ PCBs ⁽¹⁾	Metals (total)	Metals/ Pesticides	
010291-2WMW6S	--	●	●	●	●		●
121890-2WMW6D	--	●	●	●	●		●

- 1 Polychlorinated biphenyls.
- 2 Target Analyte List (TAL) Metals plus boron and cyanide.
- 3 Toxicity Characteristic Leaching Procedure (TCLP) for metals and pesticides.
- 4 Radiological analyses include gross alpha and gross beta analyses.
- 5 ● - Indicates samples analyzed at a fixed-base laboratory.
- 6 090690-2WTB9 (4-6) is a field duplicate of 2WTB2 (0-2).
- 7 083190-2WTB9 (4-6) is a field duplicate of 2WTB3 (4-6).
- 8 2WTB7 (25-27) is a field duplicate of 2WTB7 (0-2).
- 9 2WTB11 (0-2) is a field duplicate of 2WMW5 (0-2).
- 10 112690-2WSD10 is a field duplicate of 112690-2WSD1.
- 11 121090-2WSW3 is a field duplicate of 121090-2WSW2.

TABLE 7-2
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI - ECOLOGICAL
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Type	Analysis			
		Target Compound List (TCL)		TAL Metals ⁽²⁾ (Total)	Percent Body Lipids
		Pesticides	PCB ⁽¹⁾		
AVIAN ⁽³⁾					
90 MBO 01	Tissue	● ⁽⁴⁾	●	●	●
90 MBO 02	Tissue	●	●	●	●
90 MBO 03	Tissue	●	●	●	●
90 MBO 04	Tissue	●	●	●	●
90 MBO 05	Tissue	●	●	●	●
90 MBO 06	Tissue	●	●	●	●
90 MBO 07	Tissue	●	●	●	●
90 MBO 08	Tissue	●	●	●	●
90 MBO 09	Tissue	●	●	●	●
90 MBO 10	Tissue	●	●	●	●
90 MBO 11	Tissue	●	●	●	●
90 MBO 12	Tissue	●	●	●	●
90 MBO 13	Tissue	●	●	●	●
90 MBO 14	Tissue	●	●	●	●

TABLE 7-2 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI - ECOLOGICAL
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Type	Analysis			
		Target Compound List (TCL)		TAL Metals ⁽²⁾ (Total)	Percent Body Lipids
		Pesticides	PCB ⁽¹⁾		
AVIAN-CONTROL					
90 MBO 15	Tissue	●	●	●	●
90 MBO 16	Tissue	●	●	●	●
90 MBO 17	Tissue	●	●	●	●
AMPHIBIAN ⁽⁵⁾					
Pond 1A	Tissue	●	●	●	●
Pond 1A	Liver	●	●		●
Pond 1B	Tissue	●	●	●	●
Pond 1B	Liver	●	●		●
Pond 1C	Tissue	●	●	●	●
Pond 1C	Liver	●	●		●
Pond 1D	Tissue	●	●	●	●
Pond 1D	Liver	●	●		●

TABLE 7-2 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI - ECOLOGICAL
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Type	Analysis			
		Target Compound List (TCL)		TAL Metals ⁽²⁾ (Total)	Percent Body Lipids
		Pesticides	PCB ⁽¹⁾		
AMPHIBIAN - CONTROL ⁽⁶⁾					
90 MBO 18	Tissue	●	●	●	●
90 MBO 18	Liver	●	●		●

1 Polychlorinated Biphenyls

2 Target Analyte List (TAL) metals plus cyanide.

3 Gray Catbird fledglings were trapped in both Area A Downstream and Area A Wetland. Information was not available to determine which of the sites the fledglings were collected from, so the samples are listed under both the Area A Downstream and Area A Wetland.

4 ● - Indicates samples analyzed at a fixed-based laboratory.

5 Frogs.

6 Amphibian Control samples are applicable to Area A Downstream and Area A Wetland.

TABLE 7-3

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)				TCLP ⁽²⁾	TAL Metals ⁽³⁾		Engineering ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽¹⁾		Total	Dissolved	
ROUND 1 - GROUNDWATER									
2WGW2D	--	● ⁽⁵⁾	●				●	●	
2WGW3S	--	●	●				●	●	
2WGW3D	--	●	●				●	●	
2WGW5S	--	●	●				●	●	
2WGW5D	--	●	●				●	●	
2WGW6S	--	●	●				●	●	
2WGW6D	--	●	●				●	●	
2WGW21S	--	●	●				●	●	
2WGW21D	--	●	●				●	●	
2WGW22D	--	●	●				●	●	
ROUND 1 - SEDIMENT									
2WSD10	0-0.5			○ ⁽⁶⁾					
2WSD11	0-0.5			○					
2WSD12	0-0.5			○					
2WSD13	0-0.5			○					
2WSD14	0-0.5			●/○					

TABLE 7-3 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)				TCLP ⁽²⁾	TAL Metals ⁽³⁾		Engineering ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽¹⁾		Total	Dissolved	
2WSD15	0-0.5			○					
2WSD16	0-0.5			○					
2WSD17	0-0.5			○					
2WSD18	0-0.5			○					
2WSD19	0-0.5			○					
2WSD20	0-0.5			○					
2WSD21	0-0.5			○					
2WSD22	0-0.5			○					
2WSD27	0-0.5			○					
2WSD28	0-0.5			○					
2WSD29	0-0.5			○					
2WSD30	0-0.5			○					
2WSD31	0-0.5			○					
2WSD32	0-0.5			○					
2WSD33	0-0.5			○					
2WSD34	0-0.5			●/○					
2WSD35	0-0.5			○					
2WSD36	0-0.5			○					

TABLE 7-3 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)				TCLP ⁽²⁾	TAL Metals ⁽³⁾		Engineering ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽¹⁾		Total	Dissolved	
2WSD37	0-0.5			○					
2WSD38	0-0.5			●/○					
2WSD39	0-0.5			●/○		●			●
2WSD40	0-0.5			●/○					
2WSD41	0-0.5			●/○					
2WSD42	0-0.5			○					

ROUND 1 - SURFACE WATER

2WSW1	Surface	●		●	●		●	●	
2WSW2	Surface	●	●	●	●		●	●	
2WSW6	Surface	●		●	●		●	●	
2WSW7	Surface	●		●	●		●	●	
2WSW8	Surface	●		●	●		●		
2WSW9	Surface	●		●	●		●		
2WSW10	Surface	●		●	●		●		
2WSW11	Surface	●		●	●		●	●	
2WSW12	Surface	●		●	●		●	●	

TABLE 7-3 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)				TCLP ⁽²⁾	TAL Metals ⁽³⁾		Engineering ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽¹⁾		Total	Dissolved	

ROUND 2 - GROUNDWATER

2WGW2D-2	--	●	●				●	●	
2WGW3S-2	--	●	●				●	●	
2WGW3D-2	--	●	●				●	●	
2WGW5S-2	--	●	●				●	●	
2WGW5D-2	--	●	●				●	●	
2WGW6D-2	--	●	●				●	●	
2WGW6D-D-2 ⁽⁷⁾	--	●	●				●	●	
2WGW21S-2	--	●	●				●	●	
2WGW21D-2	--	●	●				●	●	
2WGW22D-2	--	●	●				●	●	

1 Polychlorinated biphenyls.

2 Toxicity Characteristic Leaching Procedure (TCLP) for metals only.

3 TAL Metals plus boron and hardness.

4 Engineering Characteristics for soil include grain size distribution, moisture content, specific gravity, organic content, cation exchange capacity, pH, and total organic carbon content.

5 ● - Indicates samples analyzed at fixed base laboratory.

6 ○ - Indicates samples field screened with a portable gas chromatograph.

7 2WGW6D-D-2 is a field duplicate of 2WGW6D-2.

TABLE 7-4

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - FOCUSED FEASIBILITY STUDIES⁽¹⁾
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)				TAL Metals ⁽³⁾ (Total)	Engineering ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽²⁾		
SEDIMENT							
2WSD23	0-1			● ⁽⁵⁾	●		●
2WSD24	0-1			●	●		●
2WSD25	0-1			●	●		●
2WSD26	0-1			●	●		●
T1-A	0-1	●	●	●	●	●	●
T1-B	0-1	●	●	●	●	●	●
T2-A	0-1	●	●	●	●	●	
DUP-03 ⁽⁶⁾	0-1	●	●	●	●	●	●
T2-B	0-1	●	●	●	●	●	●
T3-A	0-1	●	●	●	●	●	●
T3-B	0-1	●	●	●	●	●	●
T4-A	0-1	●	●	●	●	●	●
T4-B	0-1	●	●	●	●	●	●
T5-A	0-1	●	●	●	●	●	●

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TABLE 7-4 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - FOCUSED FEASIBILITY STUDIES⁽¹⁾
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis					
		Target Compound List (TCL)				TAL Metals ⁽³⁾ (Total)	Engineering ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽²⁾		
T5-B	0-1	●	●	●	●	●	●
T6-A	0-1	●	●	●	●	●	●
DUP-05 ⁽⁷⁾	0-1	●	●	●	●	●	●
T6-B	0-1	●	●	●	●	●	●
T7-A	0-1	●	●	●	●	●	●
T7-B	0-1	●	●	●	●	●	●
T8-A	0-1	●	●	●	●	●	●
T8-B	0-1	●	●	●	●	●	●
T9-A	0-1	●	●	●	●	●	●
T9-B	0-1	●	●	●	●	●	●
T10-A	0-1	●	●	●	●	●	●
T10-B	0-1	●	●	●	●	●	●

TABLE 7-4 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - FOCUSED FEASIBILITY STUDIES⁽¹⁾
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

- 1 Samples 2WSD23, 2WSD24, 2WSD25, and 2WSD26 were collected as part of the Area A Downstream/OBDA Focused Feasibility Study (FFS). The remaining samples were collected as part of the Area A Landfill FFS.
- 2 Polychlorinated Biphenyls.
- 3 Target Analyte List (TAL) metals plus boron and cyanide.
- 4 Engineering parameters for sediment include grain size distribution, moisture content, and total organic carbon content.
- 5 ● - Indicates samples analyzed at a fixed-base laboratory.
- 6 DUP-03 is a field duplicate of T2-A.
- 7 DUP-05 is a field duplicate of T6-A.

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	011591-2WMW1D	2WGW21D	2WGW21D	2WGW21D-2	2WGW21D2	2WGW21S	2WGW21S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1
SAMPLE DATE:	01/15/91	04/04/94	04/04/94	07/07/94	07/07/94	03/18/94	03/18/94
LOCATION:	2WMW1D	2WMW21D	2WMW21D	2WMW21D	2WMW21D	2WMW21S	2WMW21S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
VOLATILES (UG/L)							
CARBON DISULFIDE	5 U	10 U		10 U		2 J	
XYLENES, TOTAL	5 U	10 U		10 U		10 U	
SEMIVOLATILES (UG/L)							
2-METHYLPHENOL	10 U	10 U		10 U		10 U	
4-METHYLPHENOL	10 U	10 U		10 U		10 U	
BENZOIC ACID	50 U	50 U		25 UJ		50 U	
BIS(2-ETHYLHEXYL)PHTHALATE	10 U	10 U		10 UJ		10 U	
DI-N-BUTYL PHTHALATE	10 U	10 U		10 UJ		10 U	
DI-N-OCTYL PHTHALATE	10 U	06 J		10 UJ		10 U	
DIETHYL PHTHALATE	10 U	10 U		10 UJ		10 U	
PHENOL	10 U	10 U		10 U		10 U	
INORGANICS (UG/L)							
ALUMINUM	300 U	150 U	15.0 U	154	45.9 U	216	36.5
ANTIMONY	25.0 U	13.0 U	13.0 U	12.0 R	12.0 R	15.0 UR	15.0 UR
ARSENIC	3.0 U	3.4 J	2.6 J	5.0 U	5.0 U	109 J	138
BARIUM	16.0	52.6 J	44.8	41.3	33.6	263 J	252 J
BERYLLIUM	1.0 U	1.0 U	1.3 U	1.0 U	1.0 U	1.3 J	1.2 J
BORON	1.3 R	40.1 U	50.0 U	32.5 U	36.7 U	3260 J	3340 J
CADMIUM	2.0 U	3.0 U	3.0 U	2.0 U	2.0 U	3.0 UJ	3.6 R
CALCIUM	9330	40300	39900	52100	49800	266000 J	277000
CHROMIUM	5.0 U	4.0 U	4.0 U	3.5 J	3.0 U	3.6 J	5.7 U
COBALT	5.0 U	7.2 J	5.0 U	3.0 U	3.0 U	5.7 U	5.8 U
COPPER	5.0 U	5.0 U	5.0 U	2.8 J	2.0 UJ	43.7	12.0 U
CYANIDE	5.0 UJ						
IRON	85.1 J	24300	7230	19700	4960	528 J	114 J
LEAD	2.2 J	5.2 J	2.0 UJ	8.4 U	3.5 J	2.4 J	2.0 UJ
MAGNESIUM	1400	6250	6250	6890	6660	952000 J	1030000 J
MANGANESE	2.3	841	832	730	645	3030	2800
NICKEL	23.4 J	11.0 U	11.0 U	7.0 U	7.0 U	12.0 U	10.0 U

TABLE 7-5
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	011591-2WMW1D	2GW21D	2GW21D	2GW21D-2	2GW21D2	2GW21S	2GW21S
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1
SAMPLE DATE:	01/15/91	04/04/94	04/04/94	07/07/94	07/07/94	03/18/94	03/18/94
LOCATION:	2WMW1D	2WMW21D	2WMW21D	2WMW21D	2WMW21D	2WMW21S	2WMW21S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Shallow	Shallow
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
INORGANICS (UG/L)							
POTASSIUM	1120	3060 J	3090	4820	4820	815000 J	843000 J
SELENIUM	1.0 U	1.0 U	1.0 U	5.0 UJ	5.0 UJ	3.0 UJ	30.0 UJ
SILVER	7.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U
SODIUM	28900	51500	52300	59000	56300	7890000 J	8040000 J
THALLIUM	2.0 U	1.0 UJ	1.4 U	5.0 UJ	5.0 UJ	15.2 J	10.0 UJ
VANADIUM	20.0 U	4.0 U	4.0 U	3.0 U	3.0 U	26.0 J	32.0 J
ZINC	20.2 J	11.0 J	15.3 U	12.0 U	8.9 U	2.0 U	2.0 U
RADIONUCLIDES (PCI/L)							
GROSS ALPHA	0 +/- 19						
GROSS BETA	25 +/- 27						
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃		136	124	154		5100	

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW21S-2	2WGW21S2	2WGW22D	2WGW22D	2WGW22D-2	2WGW22D2	011491-2WMW2D
INVESTIGATION:	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	07/07/94	07/07/94	04/05/94	04/05/94	07/07/94	07/07/94	01/14/91
LOCATION:	2WMW21S	2WMW21S	2WMW22D	2WMW22D	2WMW22D	2WMW22D	2WMW2D
SCREEN DEPTH:	Shallow	Shallow	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
VOLATILES (UG/L)							
CARBON DISULFIDE	10 U		10 U		10 U		5 U
XYLENES, TOTAL	10 U		10 U		10 U		5 U
SEMIVOLATILES (UG/L)							
2-METHYLPHENOL	10 UJ		10 U		2 J		10 U
4-METHYLPHENOL	10 UJ		10 U		3 J		10 U
BENZOIC ACID	25 UJ		50 U		0.5 J		50 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 UJ		10 U		10 U		10 U
DI-N-BUTYL PHTHALATE	10 UJ		10 U		10 U		10 U
DI-N-OCTYL PHTHALATE	10 UJ		10 U		10 U		10 U
DIETHYL PHTHALATE	10 UJ		10 U		10 U		10 U
PHENOL	10 UJ		10 U		14		10 U
INORGANICS (UG/L)							
ALUMINUM	4160	28.9 U	71.0 U	76.9 U	306 U	34.8 U	139
ANTIMONY	12.0 R	12.0 R	13.0 U	13.0 U	12.0 U	12.0 U	25.0 U
ARSENIC	56.1	49.5	2.0 U	2.0 U	3.0 U	3.0 U	3.0 U
BARIUM	166 J	143 J	107 J	102	84.0	72.3	39.0
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
BORON	3070	3010	32.1 U	50.0 U	21.3 U	21.2 U	1.3 R
CADMIUM	2.0 R	2.0 R	3.0 U	3.0 U	2.0 U	2.0 U	2.0 U
CALCIUM	296000	291000	33200	33700	25200	24900	7530
CHROMIUM	13.8 J	3.0 U	4.0 U	4.0 U	3.0 U	3.0 U	5.0 U
COBALT	3.7 J	3.0 U	5.0 U	5.7 U	3.0 U	3.0 U	5.0 U
COPPER	44.6 J	37.0 J	5.0 U	5.0 U	2.0 U	2.0 U	5.0 U
CYANIDE							5.0 UJ
IRON	7500	89.5 U	705	47.0 U	9270	28.3 U	256 J
LEAD	15.1 U	2.8 R	2.5 J	2.0 UJ	10.1	4.4 J	22.4 J
MAGNESIUM	1080000	1050000	3380 J	3460	4880	4770	1700
MANGANESE	813	657	18.0	11.8	149	65.3	27.4
NICKEL	25.6 U	10.7 U	11.0 U	11.0 U	7.0 U	7.0 U	20.6 J

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TABLE 7-5
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WGW21S-2	2WGW21S2	2WGW22D	2WGW22D	2WGW22D-2	2WGW22D2	011491-2WMMW2D
INVESTIGATION:	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2	PH1
SAMPLE DATE:	07/07/94	07/07/94	04/05/94	04/05/94	07/07/94	07/07/94	01/14/91
LOCATION:	2WMMW21S	2WMMW21S	2WMMW22D	2WMMW22D	2WMMW22D	2WMMW22D	2WMMW2D
SCREEN DEPTH:	Shallow	Shallow	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
INORGANICS (UG/L)							
POTASSIUM	325000	319000	1180 J	1230	2290 U	2510 U	715
SELENIUM	5.0 UJ	5.0 UJ	1.0 U	1.0 U	3.0 U	3.0 U	1.0 U
SILVER	2.0 UJ	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	7.0 U
SODIUM	8500000	8180000	7590	7690	7580	7560	40500
THALLIUM	5.2 U	12.1 U	1.0 U	1.5 U	4.6 J	2.0 UJ	2.0 U
VANADIUM	25.1	11.3 U	4.0 U	4.0 U	3.9 U	3.0 U	20.0 U
ZINC	3.2 U	2.0 U	6.8 J	4.4 U	14.9 U	20.6 U	62.1 J
RADIONUCLIDES (PCI/L)							
GROSS ALPHA							4.7 +/- 2.1
GROSS BETA							3.8 +/- 3.0
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃	6150		96	96.0	82		

TABLE 7-5
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WGW2D	2WGW2D	2WGW2D-2	2WGW2D2	011191-2WMW3D	2WGW3D	2WGW3D
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	04/05/94	04/05/94	07/07/94	07/07/94	01/11/91	03/18/94	03/18/94
LOCATION:	2WMW2D	2WMW2D	2WMW2D	2WMW2D	2WMW3D	2WMW3D	2WMW3D
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered
VOLATILES (UG/L)							
CARBON DISULFIDE	10 U		10 U		5 U	10 U	
XYLENES, TOTAL	10 U		10 U		5 U	10 U	
SEMIVOLATILES (UG/L)							
2-METHYLPHENOL	10 U		10 U		10 U	10 U	
4-METHYLPHENOL	10 U		10 U		10 U	10 U	
BENZOIC ACID	50 U		0.6 J		12 J	50 U	
BIS(2-ETHYLHEXYL)PHTHALATE	10 U		10 U		10 U	11	
DI-N-BUTYL PHTHALATE	10 U		10 U		10 U	10 U	
DI-N-OCTYL PHTHALATE	10 U		10 U		10 U	3 J	
DIETHYL PHTHALATE	10 U		10 U		10 U	1 J	
PHENOL	10 U		10 U		10 U	10 U	
INORGANICS (UG/L)							
ALUMINUM	159 U	120 U	690	80.7 U	30.0 U	1070	14.0 U
ANTIMONY	13.0 U	13.0 U	12.0 U	12.0 U	25.0 U	15.0 UR	15.0 U
ARSENIC	2.0 UJ	2.0 UJ	3.0 U	6.1 U	3.0 U	4.6 J	2.9 J
BARIUM	15.5 J	13.9	29.9	21.8	613	904 J	805
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ
BORON	29.0 U	50.0 U	43.0 U	32.8 U	1.5 R	109 R	116
CADMIUM	3.0 U	3.0 U	2.7 J	2.0 U	7.7 J	10.9 J	18.1
CALCIUM	5920	5980	19700	18400	72200	92500 J	92500
CHROMIUM	4.0 U	4.0 U	3.0 U	3.0 U	5.0 U	3.0 U	3.0 UJ
COBALT	5.0 U	5.0 U	3.0 U	3.0 U	5.0 U	4.0 U	4.0 UJ
COPPER	5.0 U	5.0 U	10.6	3.7 J	5.0 U	17.2 U	2.3 U
CYANIDE					5.0 U		
IRON	105 U	18.6 U	1510	58.2 U	62600	108000 J	73600 J
LEAD	9.8	6.7 J	32.7	13.3	10.0 UJ	3.8 J	2.1 J
MAGNESIUM	1340 J	1340	3100	2840	108000	131000 J	130000
MANGANESE	21.1	21.7	47.4	6.8	3630	5190	4900
NICKEL	11.0 U	11.0 U	15.2 U	7.0 U	18.9 J	11.1 U	10.0 U

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW2D	2WGW2D	2WGW2D-2	2WGW2D2	011191-2WMW3D	2WGW3D	2WGW3D
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	04/05/94	04/05/94	07/07/94	07/07/94	01/11/91	03/18/94	03/18/94
LOCATION:	2WMW2D	2WMW2D	2WMW2D	2WMW2D	2WMW3D	2WMW3D	2WMW3D
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered
INORGANICS (UG/L)							
POTASSIUM	557 J	488	1650 U	1230 U	26400	44700 J	42500 J
SELENIUM	1.0 U	1.0 U	3.0 U	3.0 U	3.6	3.0 UJ	3.0 UJ
SILVER	2.0 U	2.0 U	2.0 U	2.0 U	7.0 U	7.2 U	3.9 J
SODIUM	17900	17900	39800	39400	1140000	1290000 J	1280000 J
THALLIUM	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ	20.0 U	10.0 UJ	1.3 J
VANADIUM	4.0 U	4.0 U	3.5 U	3.0 U	20.0 U	5.0 UJ	5.0 U
ZINC	17.0 J	22.6	26.7 U	21.6 U	16.1 J	15.4	5.2
RADIONUCLIDES (PCI/L)							
GROSS ALPHA					42.2 +/- 25.1		
GROSS BETA					51 +/- 30.6		
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃	18	16.0	62			840	

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TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW3D-2	2WGW3D2	121190-2WMW3S	2WGW3S	2WGW3S	2WGW3S-2	2WGW3S2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	06/26/94	06/26/94	12/11/90	03/18/94	03/18/94	06/26/94	06/26/94
LOCATION:	2WMW3D	2WMW3D	2WMW3S	2WMW3S	2WMW3S	2WMW3S	2WMW3S
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered
VOLATILES (UG/L)							
CARBON DISULFIDE	10 U		5 U	10 U		10 U	
XYLENES, TOTAL	10 U		5 U	10 U		10 U	
SEMI-VOLATILES (UG/L)							
2-METHYLPHENOL	10 U		10 U	10 U		10 U	
4-METHYLPHENOL	10 U		10 U	10 U		10 U	
BENZOIC ACID	50 U		50 U	50 U		50 U	
BIS(2-ETHYLHEXYL)PHTHALATE	10 U		10 U	10 U		10 U	
DI-N-BUTYL PHTHALATE	10 U		10 U	1 J		10 U	
DI-N-OCTYL PHTHALATE	10 U		10 U	10 U		10 U	
DIETHYL PHTHALATE	10 U		10 U	1 J		10 U	
PHENOL	10 U		10 U	10 U		10 U	
INORGANICS (UG/L)							
ALUMINUM	2410	69.5	39.6	408	28.9	181	62.3
ANTIMONY	3.0 U	12.0 U	25.0 U	15.0 U	15.0 UR	3.0 U	12.0 U
ARSENIC	1.9 J	2.4	7.6	5.3 J	22.1	23.0	29.0
BARIUM	312	286	396	187 J	707	243	263
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 U
BORON	89.7 J	61.1	0.97 R	292 J	245 J	188	161
CADMIUM	1.2 J	2.0 U	10.6	4.3 J	30.6 J	1.0 U	2.0 U
CALCIUM	71500	73900	67300	40400 J	137000	57100	61700
CHROMIUM	4.9	3.0 U	5.0 U	3.0 U	3.0 UJ	2.9	3.0 U
COBALT	3.1	3.0 U	5.0 U	19.9 U	4.0 UJ	2.1	3.0 U
COPPER	8.3	2.0 U	6.2 J	6.7 U	7.6 U	1.1 U	2.0 U
CYANIDE			5.0 U				
IRON	87600	19200	75400	39700 J	123000 J	53800	56300
LEAD	2.5 U	2.0	10.0 U	2.4 J	2.0 UJ	2.0 UJ	2.0 U
MAGNESIUM	38100	36000	126000	43000 J	194000	97700	84600
MANGANESE	1150	958	3200	7920	7490	3100	3290
NICKEL	12.0 U	7.0 U	7.0 U	10.0 U	12.1 J	12.0 U	7.0 U

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TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW3D-2	2WGW3D2	121190-2WMW3S	2WGW3S	2WGW3S	2WGW3S-2	2WGW3S2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	06/26/94	06/26/94	12/11/90	03/18/94	03/18/94	06/26/94	06/26/94
LOCATION:	2WMW3D	2WMW3D	2WMW3S	2WMW3S	2WMW3S	2WMW3S	2WMW3S
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered
INORGANICS (UG/L)							
POTASSIUM	9880	9430	37100	15600 J	79000 J	31600	28400
SELENIUM	2.0 UJ	2.0 U	2.3 J	3.0 UJ	30.0 UJ	2.0 UJ	2.0 U
SILVER	1.0 U	2.0 U	7.0 U	3.8 U	9.8 J	1.5 J	2.0 U
SODIUM	293000	292000	1360000	529000 J	1880000 J	932000	793000
THALLIUM	20.0 UR	20.0 U	10.0 U	10.0 UJ	1.4 J	20.0 UR	20.0 U
VANADIUM	4.7	3.0 U	20.0 U	5.0 UJ	5.0 UJ	2.7	3.0 U
ZINC	18.5	6.6	15.3 J	7.0 U	3.0 J	8.3	2.0 U
RADIONUCLIDES (PC/L)							
GROSS ALPHA			0 +/- 55.8				
GROSS BETA			40.2 +/- 35.7				
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃	400			1280		556	

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TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW5D	2WGW5D	2WGW5D-2	2WGW5D2	121490-2WMMW5S	2WGW5S	2WGW5S
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	04/06/94	04/06/94	07/09/94	07/09/94	12/14/90	03/19/94	03/19/94
LOCATION:	2WMMW5D	2WMMW5D	2WMMW5D	2WMMW5D	2WMMW5S	2WMMW5S	2WMMW5S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered
VOLATILES (UG/L)							
CARBON DISULFIDE	10 U		10 U		5 U	10 U	
XYLENES, TOTAL	10 U		10 U		1 J	10 U	
SEMIVOLATILES (UG/L)							
2-METHYLPHENOL	10 U		10 U		10 U	10 U	
4-METHYLPHENOL	10 U		10 U		10 U	10 U	
BENZOIC ACID	0.9 J		50 U		50 U	50 UJ	
BIS(2-ETHYLHEXYL)PHTHALATE	10 U		10 U		10 U	10 U	
DI-N-BUTYL PHTHALATE	10 U		10 U		10 U	10 U	
DI-N-OCTYL PHTHALATE	10 U		10 U		10 U	10 U	
DIETHYL PHTHALATE	10 U		10 U		10 U	10 U	
PHENOL	10 U		10 U		10 U	10 U	
INORGANICS (UG/L)							
ALUMINUM	70.2 U	54.3 U	60.0 U	71.4 U	30.0 U	267	14.0 U
ANTIMONY	13.0 U	13.0 U	12.0 U	12.0 U	25.0 U	15.0 UR	15.0 U
ARSENIC	4.4 J	5.5	2.0 U	2.0 U	3.0 U	4.9 J	3.2 J
BARIUM	161 J	165	193	189	167	754 J	187
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ
BORON	207	214	243	223	1.6 R	253 J	293
CADMIUM	3.0 U	3.0 U	2.0 U	2.0 UJ	6.4	8.3 J	5.2
CALCIUM	42500	41800	44900	44400	52300	142000 J	41700
CHROMIUM	4.0 U	4.0 U	3.0 U	3.0 U	5.0 U	3.0 U	3.0 UJ
COBALT	16.3 J	19.3 U	15.9	17.7	12.1	4.0 U	15.3 U
COPPER	5.0 U	5.0 U	2.8 J	2.0 U	7.9 J	9.5 U	2.0 U
CYANIDE					5.0		
IRON	24900	26800	27600	26600	44800	131000 J	39200 J
LEAD	2.0 UJ	2.0 UJ	1.0 U	1.6 J	2.0 U	1.3 J	2.0 UJ
MAGNESIUM	28300	29400	36800	36500	50800	203000 J	43800
MANGANESE	5770	6050	7160	7090	8130	7900	7870
NICKEL	11.0 U	11.0 U	7.0 U	7.0 U	7.0 U	14.4 U	12.8 J

TABLE 7-5
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WGW5D	2WGW5D	2WGW5D-2	2WGW5D2	121490-2WMMW5S	2WGW5S	2WGW5S
INVESTIGATION:	PH2-1	PH2-1	PH2-2	PH2-2	PH1	PH2-1	PH2-1
SAMPLE DATE:	04/06/94	04/06/94	07/09/94	07/09/94	12/14/90	03/19/94	03/19/94
LOCATION:	2WMMW5D	2WMMW5D	2WMMW5D	2WMMW5D	2WMMW5S	2WMMW5S	2WMMW5S
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered
INORGANICS (UG/L)							
POTASSIUM	8280	7950	9080	9430	17300 J	86600 J	15700 J
SELENIUM	1.0 UJ	1.0 UJ	3.0 J	3.0 UJ	2.2 J	3.0 UJ	3.0 UJ
SILVER	2.0 U	2.0 U	2.0 U	2.0 UJ	7.0 U	6.5 U	4.5
SODIUM	344000	362000	440000	432000	654000	521000 J	537000
THALLIUM	1.0 U	1.7 U	9.0 J	8.8 J	10.0 U	1.0 UJ	1.0 UJ
VANADIUM	4.0 U	4.0 U	3.0 U	3.5 U	20.0 U	5.0 UJ	5.0 U
ZINC	17.2 J	21.6	13.2 U	7.7 U	12.4 J	4.1 U	3.8 J
RADIONUCLIDES (PCI/L)							
GROSS ALPHA					0 +/- 23.3		
GROSS BETA					15.8 +/- 15		
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3	244		280			292	

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW5S-2	2WGW5S2	121890-2WMW6D	2WGW6D	2WGW6D	2WGW6D-2	2WGW6D-D-2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	07/09/94	07/09/94	12/18/90	03/16/94	03/16/94	07/10/94	07/10/94
LOCATION:	2WMW5S	2WMW5S	2WMW6D	2WMW6D	2WMW6D	2WMW6D	2WMW6D
SCREEN DEPTH:	Shallow	Shallow	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered
VOLATILES (UG/L)							
CARBON DISULFIDE	10 U		5 U	10 U		10 U	10 U
XYLENES, TOTAL	10 U		5 U	10 U		10 U	10 U
SEMIVOLATILES (UG/L)							
2-METHYLPHENOL	10 U		10 U	10 U		10 U	10 U
4-METHYLPHENOL	10 U		10 U	10 U		10 U	10 U
BENZOIC ACID	50 U		50 U	0.5 J		50 U	50 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U		13	10 U		30 J	31 J
DI-N-BUTYL PHTHALATE	10 U		10 U	10 U		10 U	10 U
DI-N-OCTYL PHTHALATE	10 U		10 U	10 U		10 U	10 U
DIETHYL PHTHALATE	10 U		10 U	10 U		10 U	10 U
PHENOL	10 U		10 U	10 U		10 U	10 U
INORGANICS (UG/L)							
ALUMINUM	531 U	373 U	71.7	9910	7520	668	689
ANTIMONY	120 U	120 U	25.0 U	15.0 U	15.0 UJ	15.0 U	12.0 U
ARSENIC	20 U	20 U	3.0 U	2.3 J	2.0 U	6.5 J	5.0 UJ
BARIUM	207	210	26.2	75.2	71.8	25.0	25.3
BERYLLIUM	1.0 U	1.0 U	1.0 U	3.6	4.2	1.0 U	1.0 U
BORON	313	310	8.1 R	403	400	163	167
CADMIUM	3.9 J	2.0 U	2.0 U	4.8 U	4.5 U	2.0 U	2.0 U
CALCIUM	46500	46800	40500	127000	130000	40100	39900
CHROMIUM	3.0 U	3.0 U	5.0 U	3.0 U	3.0 UJ	3.0 U	3.0 U
COBALT	14.7	17.7	5.0 U	37.5	40.9	3.0 U	5.4 J
COPPER	6.1 J	2.0 UJ	5.5 J	4.2	2.0 U	10.2	9.8
CYANIDE			5.0 UJ				
IRON	48100	48700	2310	10100	1630	23400	25400
LEAD	3.3	1.0 U	2.0	2.0 UJ	2.0 U	3.4 U	3.7 U
MAGNESIUM	49600	50100	8830	38500	38600	9970	9990
MANGANESE	9270	9360	673	3280	3240	819	832
NICKEL	7.0 U	7.0 U	7.0 U	116	101	19.2	9.3 J

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW5S-2	2WGW5S2	121890-2WMMW6D	2WGW6D	2WGW6D	2WGW6D-2	2WGW6D-D-2
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	07/09/94	07/09/94	12/18/90	03/16/94	03/16/94	07/10/94	07/10/94
LOCATION:	2WMMW5S	2WMMW5S	2WMMW6D	2WMMW6D	2WMMW6D	2WMMW6D	2WMMW6D
SCREEN DEPTH:	Shallow	Shallow	Deep	Deep	Deep	Deep	Deep
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered
INORGANICS (UG/L)							
POTASSIUM	14700	15500	8330 J	11300	11900	6960	7120
SELENIUM	3.0 UJ	3.0 UJ	1.0 U	3.0 UJ	3.0 UJ	5.0 UJ	5.1 J
SILVER	2.0 U	2.4 U	7.0 U	2.0 UJ	2.0 UJ	2.0 U	2.0 U
SODIUM	580000	583000	94700	74100	75600	69300	69100
THALLIUM	8.6 J	7.0 J	2.0 U	1.0 UR	1.0 UR	5.0 U	6.0 J
VANADIUM	3.3 U	3.0 U	20.0 U	5.0 U	7.0 U	3.0 U	3.0 U
ZINC	3.1 U	6.1 U	21.1 J	274	262	47.6	49.1
RADIONUCLIDES (PCI/L)							
GROSS ALPHA			4.6 +/- 5.7				
GROSS BETA			12.4 +/- 3.9				
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3	328			476		144	140

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW6D2	2WGW6DD2	010291-2WMMW6S	2WGW6S	2WGW6S		
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1	//	//
SAMPLE DATE:	07/10/94	07/10/94	01/02/91	03/16/94	03/16/94		
LOCATION:	2WMMW6D	2WMMW6D	2WMMW6S	2WMMW6S	2WMMW6S		
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow		
FILTERING:	Filtered	Filtered	Unfiltered	Unfiltered	Filtered		
VOLATILES (UG/L)							
CARBON DISULFIDE			5 U	10 U			
XYLENES, TOTAL			5 U	10 U			
SEMIVOLATILES (UG/L)							
2-METHYLPHENOL			10 U	10 U			
4-METHYLPHENOL			10 U	10 U			
BENZOIC ACID			50 U	0.8 J			
BIS(2-ETHYLHEXYL)PHTHALATE			10 U	10 U			
DI-N-BUTYL PHTHALATE			10 U	10 U			
DI-N-OCTYL PHTHALATE			10 U	10 U			
DIETHYL PHTHALATE			10 U	10 U			
PHENOL			10 U	10 U			
INORGANICS (UG/L)							
ALUMINUM	84.8 U	86.2 U	2060	2260	2180		
ANTIMONY	12.0 U	13.4 J	25.0 U	15.0 U	15.0 UJ		
ARSENIC	5.0 U	5.0 U	3.0 U	2.0 UR	2.0 U		
BARIUM	20.3	19.9	38.0	17.8	15.9		
BERYLLIUM	1.0 U	1.0 U	1.0	1.6 J	2.3		
BORON	166	161	7.5 R	90.7 J	96.8		
CADMIUM	2.0 U	2.0 U	2.0 U	2.1 U	3.2 U		
CALCIUM	39600	39500	18700	27400	27600		
CHROMIUM	3.5 U	3.0 UJ	5.0 U	3.0 U	3.0 UJ		
COBALT	6.0 U	3.0 U	14.3	20.7	29.2 U		
COPPER	2.6 U	2.7 U	5.0 U	3.0 J	2.0 U		
CYANIDE			5.0 UJ				
IRON	1170 J	1120 J	3140	394	383		
LEAD	2.0 U	2.0 U	2.5 J	2.0 UJ	2.0 U		
MAGNESIUM	10100	10000	4350	5880	5870		
MANGANESE	768	730	648	665	664		
NICKEL	10.4 J	7.0 U	39.7 J	48.0	45.5 U		

TABLE 7-5

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WGW6D2	2WGW6DD2	010291-2WMW6S	2WGW6S	2WGW6S		
INVESTIGATION:	PH2-2	PH2-2	PH1	PH2-1	PH2-1		
SAMPLE DATE:	07/10/94	07/10/94	01/02/91	03/16/94	03/16/94	/ /	/ /
LOCATION:	2WMW6D	2WMW6D	2WMW6S	2WMW6S	2WMW6S		
SCREEN DEPTH:	Deep	Deep	Shallow	Shallow	Shallow		
FILTERING:	Filtered	Filtered	Unfiltered	Unfiltered	Filtered		
INORGANICS (UG/L)							
POTASSIUM	6810	6720	5510	6530	6590		
SELENIUM	5.0 UJ	5.0 UJ	1.0 U	3.0 UJ	3.0 UJ		
SILVER	2.0 U	2.0 U	7.0 U	2.0 UJ	2.0 UJ		
SODIUM	69000	69100	31200	21200	21300		
THALLIUM	5.0 U	5.0 U	2.0 UR	1.0 UR	1.0 UR		
VANADIUM	1.0 U	1.0 U	20.0 U	5.0 U	6.0 U		
ZINC	30.9	33.5	136	182	183		
RADIONUCLIDES (PC/L)							
GROSS ALPHA			2.8 +/- 2.1				
GROSS BETA			4.4 +/- 3.2				
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3				96			

TABLE 7-6
SUMMARY OF PHASE I GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 1

Analyte	Shallow Wells (1)			Deep Wells (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)						
Xylenes, total	1/3	1	2WGW5S	0/4	-	(3)
SEMIVOLATILE ORGANICS (ug/L)						
Benzoic acid	0/3	-	ND	1/4	12	2WGW3D
Bis(2-ethylhexyl) phthalate	0/3	-	ND	1/4	13	2WGW6D
INORGANICS (ug/L)						
Aluminum	2/3	39.6-2060	2WGW6S	2/4	71.7-139	2WGW2D
Arsenic	1/3	7.6	2WGW3S	0/4	-	ND
Barium	3/3	38-396	2WGW3S	4/4	16-613	2WGW3D
Beryllium	1/3	1	2WGW6S	0/4	-	ND
Cadmium	2/3	6.4-10.6	2WGW3S	1/4	7.7	2WGW3D
Calcium	3/3	18700-67300	2WGW3S	4/4	7530-72200	2WGW3D
Cobalt	2/3	12.1-14.3	2WGW6S	0/4	-	ND
Copper	2/3	6.2-7.9	2WGW5S	1/4	5.5	2WGW6D
Cyanide	1/3	5	2WGW5S	0/4	-	ND
Iron	3/3	3140-75400	2WGW3S	4/4	85.1-62600	2WGW3D
Lead	1/3	2.5	2WGW6S	3/4	2-22.4	2WGW2D
Magnesium	3/3	4350-126000	2WGW3S	4/4	1400-108000	2WGW3D
Manganese	3/3	648-8130	2WGW5S	4/4	2.3-3630	2WGW3D
Nickel	1/3	39.7	2WGW6S	3/4	18.9-23.4	2WGW1D
Potassium	3/3	5510-37100	2WGW3S	4/4	715-26400	2WGW3D
Selenium	2/3	2.2-2.3	2WGW3S	1/4	3.6	2WGW3D
Sodium	3/3	31200-1360000	2WGW3S	4/4	28900-114000	2WGW3D
Zinc	3/3	12.4-136	2WGW6S	4/4	16.1-62.1	2WGW2D

- 1 Includes samples 2WMW3S, 2WMW5S, and 2WMW6S.
- 2 Includes samples 2WMW1D, 2WMW2D, 2WMW3D, and 2WMW6D.
- 3 ND - Not Detected.

TABLE 7-7
SUMMARY OF ROUND1/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
Carbon disulfide	1/4	2	2WGW21S	-	-	NA (3)	0/6	-	ND (4)	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
Benzoic acid	1/4	0.8	2WGW6S	-	-	NA	2/6	0.5-0.9	2WGW5D	-	-	NA
Bis(2-ethylhexyl)phthalate	0/4	-	ND	-	-	NA	1/6	11	2WGW3D	-	-	NA
Di-n-butyl phthalate	1/4	1	2WGW3S	-	-	NA	0/6	-	ND	-	-	NA
Di-n-octyl phthalate	0/4	-	ND	-	-	NA	2/6	0.6-3	2WGW3D	-	-	NA
Diethyl phthalate	1/4	1	2WGW3S	-	-	NA	1/6	1	2WGW3D	-	-	NA
INORGANICS (ug/L)												
Aluminum	4/4	216-2260	2WGW6S	3/4	28.9-2180	2WGW6S	2/6	1070-9910	2WGW6D	1/6	7520	2WGW6D
Arsenic	3/3	4.9-109	2WGW21S	3/4	3.2-138	2WGW21S	4/6	2.3-4.6	2WGW3D	3/6	2.6-5.5	2WGW5D
Barium	4/4	17.8-754	2WGW5S	4/4	15.9-707	2WGW3S	6/6	15.5-904	2WGW3D	6/6	13.9-805	2WGW3D
Beryllium	2/4	1.3-1.6	2WGW6S	2/4	1.2-2.3	2WGW6S	1/6	3.6	2WGW6D	1/6	4.2	2WGW6D
Boron	4/4	90.7-3260	2WGW21S	4/4	96.8-3340	2WGW21S	2/5	207-403	2WGW6D	3/6	116-400	2WGW6D
Cadmium	2/4	4.3-8.3	2WGW5S	2/3	5.2-30.6	2WGW3S	1/6	10.9	2WGW3D	1/6	18.1	2WGW3D
Calcium	4/4	27400-266000	2WGW21S	4/4	27600-277000	2WGW21S	6/6	5920-127000	2WGW6D	6/6	5980-130000	2WGW6D
Chromium	1/4	3.6	2WGW21S	0/4	-	ND	0/6	-	ND	0/6	-	ND
Cobalt	1/4	20.7	2WGW6S	0/4	-	ND	3/6	7.2-37.5	2WGW6D	1/6	40.9	2WGW6D
Copper	2/4	3-43.7	2WGW21S	0/4	-	ND	1/6	4.2	2WGW6D	0/6	-	ND
Iron	4/4	394-131000	2WGW5S	4/4	114-123000	2WGW3S	5/6	705-108000	2WGW3D	4/6	1630-73600	2WGW3D
Lead	3/4	1.3-2.4	2WGW3S	0/4	-	ND	4/6	2.5-9.8	2WGW2D	2/6	2.1-6.7	2WGW2D
Magnesium	4/4	5880-952000	2WGW21S	4/4	5870-1030000	2WGW21S	6/6	1340-131000	2WGW3D	6/6	1340-130000	2WGW3D
Manganese	4/4	665-7920	2WGW3S	4/4	664-7870	2WGW5S	6/6	18-5770	2WGW5D	6/6	11.8-6050	2WGW5D
Nickel	1/4	48	2WGW6S	2/4	12.1-12.8	2WGW5S	1/6	116	2WGW6D	1/6	101	2WGW6D
Potassium	4/4	6530-815000	2WGW21S	4/4	6590-843000	2WGW21S	6/6	557-44700	2WGW3D	6/6	488-42500	2WGW3D
Silver	0/4	-	ND	2/4	4.5-9.8	2WGW3S	0/6	-	ND	1/6	3.9	2WGW3D
Sodium	4/4	21200-7890000	2WGW21S	4/4	21300-8040000	2WGW21S	6/6	7590-1290000	2WGW3D	6/6	7690-1280000	2WGW3D
Thallium	1/3	15.2	2WGW21S	1/3	1.4	2WGW3S	0/5	-	ND	1/5	1.3	2WGW3D
Vanadium	1/4	26	2WGW21S	1/4	32	2WGW21S	0/6	-	ND	0/6	-	ND
Zinc	1/4	182	2WGW6S	3/4	3-183	2WGW6S	6/6	6.8-274	2WGW6D	4/6	5.2-262	2WGW6D

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TABLE 7-7
SUMMARY OF ROUND1/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLAENOUS PARAMETERS (mg/L)												
Hardness as CaCO3	4/4	96-5100	2WGW21S	-	-	NA	6/6	18-840	2WGW3D	3/3	16-124	2WGW21D

- 1 Includes samples 2WGW3S, 2WGW5S, 2WGW6S, and 2WGW21S.
- 2 Includes samples 2WGW2D, 2WGW3D, 2WGW5D, 2WGW6D, 2WGW21D, and 2WGW22D.
- 3 NA - Not Analyzed.
- 4 ND - Not Detected.

TABLE 7-8
SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 1

Analyte	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
SEMIVOLATILE ORGANICS (ug/L)												
2-Methylphenol	0/3	-	ND (3)	-	-	NA (4)	1/6	2	2WGW22D	-	-	NA
4-Methylphenol	0/3	-	ND (3)	-	-	NA	1/6	3	2WGW22D	-	-	NA
Benzoic acid	0/3	-	ND (3)	-	-	NA	2/6	0.5-0.6	2WGW2D	-	-	NA
Bis(2-ethylhexyl)phthalate	0/3	-	ND (3)	-	-	NA	1/6	30.5	2WGW6D	-	-	NA
Phenol	0/3	-	ND (3)	-	-	NA	1/6	14	2WGW22D	-	-	NA
INORGANICS (ug/L)												
Aluminum	2/3	181-4160	2WGW21S	1/3	62.3	2WGW3S	4/6	154-2410	2WGW3D	1/6	69.5	2WGW3D
Antimony	0/2	-	ND	0/2	-	ND	0/5	-	ND	1/5	9.7	2WGW6D
Arsenic	2/3	23-58.1	2WGW21S	2/3	29-49.5	2WGW21S	2/6	1.9-4.5	2WGW6D	1/6	2.4	2WGW3D
Barium	3/3	166-243	2WGW3S	3/3	143-263	2WGW3S	6/6	25.15-312	2WGW3D	6/6	20.1-288	2WGW3D
Boron	3/3	188-3070	2WGW21S	3/3	161-3010	2WGW21S	3/6	89.7-243	2WGW5D	3/6	61.1-223	2WGW5D
Cadmium	1/2	3.9	2WGW5S	0/2	-	ND	2/6	1.2-2.7	2WGW2D	0/6	-	ND
Calcium	3/3	46500-296000	2WGW21S	3/3	46800-291000	2WGW21S	6/6	19700-71500	2WGW3D	6/6	18400-73900	2WGW3D
Chromium	2/3	2.9-13.8	2WGW21S	0/3	-	ND	2/6	3.5-4.9	2WGW3D	0/6	-	ND
Cobalt	3/3	2.1-14.7	2WGW5S	1/3	17.7	2WGW5S	3/6	3.1-15.9	2WGW5D	1/6	17.7	2WGW5D
Copper	2/3	6.1-44.6	2WGW21S	1/3	37	2WGW21S	5/6	2.8-10.6	2WGW2D	1/6	3.7	2WGW2D
Iron	3/3	7500-53800	2WGW3S	2/3	48700-58300	2WGW3S	6/6	1510-87600	2WGW3D	4/6	1145-26600	2WGW5D
Lead	1/3	3.3	2WGW5S	0/2	-	ND	2/6	10.1-32.7	2WGW2D	5/6	1.6-13.3	2WGW2D
Magnesium	3/3	49600-1080000	2WGW21S	3/3	50100-1050000	2WGW21S	6/6	3100-38100	2WGW3D	6/6	2840-36500	2WGW5D
Manganese	3/3	813-9270	2WGW5S	3/3	657-9360	2WGW5S	6/6	47.4-7160	2WGW5D	6/6	6.8-7090	2WGW5D
Nickel	0/3	-	ND	0/3	-	ND	1/6	14.25	2WGW6D	1/6	6.95	2WGW6D
Potassium	3/3	14700-325000	2WGW21S	3/3	15500-319000	2WGW21S	4/6	4820-9880	2WGW3D	4/6	4820-9430	2WGW3D
Selenium	0/3	-	ND	0/3	-	ND	2/6	3-3.8	2WGW6D	0/6	-	ND
Silver	1/3	1.5	2WGW3S	0/3	-	ND	0/6	-	ND	0/6	-	ND
Sodium	3/3	580000-8500000	2WGW21S	3/3	583000-8180000	2WGW21S	6/6	7580-440000	2WGW5D	6/6	7580-432000	2WGW5D
Thallium	1/2	8.6	2WGW5S	1/3	7	2WGW5S	3/5	4.25-9	2WGW5D	1/6	8.8	2WGW5D
Vanadium	2/3	2.7-25.1	2WGW21S	0/3	-	ND	1/6	4.7	2WGW3D	0/6	-	ND
Zinc	1/3	8.3	2WGW3S	0/3	-	ND	2/6	18.5-48.35	2WGW6D	2/6	6.6-32.2	2WGW6D
MISCELLANEOUS PARAMETERS (mg/L)												
Hardness as CaCO3	3/3	328-6150	2WGW21S	-	-	NA	6/6	62-400	2WGW3D	-	-	NA

1 Includes samples 2WGW3S-2, 2WGW5S-2, and 2WGW21S-2.

2 Includes samples 2WGW2D-2, 2WGW3D-2, 2WGW5D-2, 2WGW6D-2, 2WGW6D-D-2 (field duplicate of 2WGW2D-2), 2WGW21D-2, and 2WGW22D-2.
Duplicate sample results are averaged and counted as one sample.

3 ND - Not Detected.

4 NA - Not Analyzed.

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TABLE 7-9

**SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	121090-2WSW1	2WSW1	2WSW1	2WSW10	2WSW11	2WSW11	2WSW12
LOCATION:	2WSW1	2WSW1	2WSW1	2WSW10	2WSW11	2WSW11	2WSW12
SAMPLE DATE:	12/10/90	11/30/93	11/30/93	12/05/93	11/23/93	11/23/93	11/23/93
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered
VOLATILES (UG/L)							
TETRACHLOROETHENE	5 U	10 U		10 U	10 U		2 J
SEMIVOLATILES (UG/L)							
DIETHYL PHTHALATE	10 U						
INORGANICS (UG/L)							
ALUMINUM	137	20900	157	1200	99.8	94.7	66.9 J
ARSENIC	3.0 U	2.9	2.0 U	2.0 U	2.8	2.0 U	2.8
BARIUM	22.3	76.1 U	16.6 U	10.4 UJ	45.8 U	30.1 U	97.6
BORON	1.7 R	270	50.0 U	50.0 U	197	75.9 J	154
CADMIUM	13.7	2.8 U	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ
CALCIUM	7890	29300	7420	1070	27000	25700	46500
CHROMIUM	6.8	6.5 U	3.0 U	3.6 UJ	3.0 U	3.0 U	3.0 U
COBALT	5.0 U	63.9	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 U
COPPER	13.0 J	29.3 J	2.0 UJ	6.1 J	2.0 UJ	2.0 UJ	2.0 UJ
IRON	293 J	9030	309	1070 J	7100	2860	11300
LEAD	7.8	2.0 J	1.8 J	4.5 J	1.0 R	1.0 U	1.0 R
MAGNESIUM	2070	18500	2270	443	8620	8190	10300
MANGANESE	52.0 J	1860	96.1	43.7 J	624	325	596
MERCURY	0.2 U	0.2 U	0.2 U	0.2 R	0.2 U	0.2 U	0.2 U
NICKEL	7.0 U	84.7	11.0 U	11.0 UJ	11.0 U	11.0 U	11.0 U
POTASSIUM	4020 J	7010	2450	1170	8400	7990	10300
SODIUM	22100	20800	32300	1640 U	87600	82100	111000
VANADIUM	20.0 U	3.0 U	3.0 U	4.3 J	3.0 U	3.0 U	3.0 U
ZINC	22.8 J	318	31.4	60.3	14.4 U	17.9 U	16.9 U
RADIONUCLIDES (PCI/L)							
GROSS ALPHA	0.4 +/- 1.60						
GROSS BETA	1.6 +/- 2.70						
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃		148		16	128		160

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TABLE 7-9

**SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WSW12	121090-2WSW2	121090-2WSW3	2WSW2	2WSW2	2WSW6	2WSW6
LOCATION:	2WSW12	2WSW2	2WSW2	2WSW2	2WSW2	2WSW6	2WSW6
SAMPLE DATE:	11/23/93	12/10/90	12/10/90	11/23/93	11/23/93	11/30/93	11/30/93
INVESTIGATION:	PH2-1	PH1	PH1	PH2-1	PH2-1	PH2-1	PH2-1
FILTERING:	Filtered	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered
VOLATILES (UG/L)							
TETRACHLOROETHENE		5 U	5 U	10 U		10 U	
SEMIVOLATILES (UG/L)							
DIETHYL PHTHALATE		10 U	2 J	10 U			
INORGANICS (UG/L)							
ALUMINUM	95.4	153	98.2	586	86.3	20800	259
ARSENIC	2.0 U	3.0 U	3.0 U	2.0 U	2.0 U	2.0 U	2.0 U
BARIIUM	83.3	23.8	26.2	115	91.2	73.5 U	23.1 U
BORON	119	2.1 R	2.2 R	369	111	121	222
CADMIUM	2.0 UJ	126 J	7.1 J	2.0 UJ	2.1 U	4.4 U	2.0 UJ
CALCIUM	45300	10000	11900	36700	35600	29800	7640
CHROMIUM	3.0 U	5.0 U	5.0 U	3.0 U	3.0 U	4.5 U	3.0 U
COBALT	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	66.8	5.0 U
COPPER	2.0 UJ	13.2 J	9.7 J	3.1 U	5.3 U	16.8 U	2.0 UJ
IRON	19400	4010 J	2820 J	3320	699	10800	548
LEAD	1.0 U	2.0	2.0 U	2.1 J	1.0 U	5.0 J	1.0 R
MAGNESIUM	9630	4350	4920	11600	10800	18200	2410
MANGANESE	571	136	126	591	551	1870	99.8
MERCURY	0.22 J	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
NICKEL	11.0 U	7.3	7.0 U	11.1 J	11.0 U	82.1	11.0 U
POTASSIUM	9800	7990 J	8960 J	15300	14700	6810	2490
SODIUM	103000	56700	68100	143000	133000	19700	34900
VANADIUM	3.0 U	20.0 U	20.0 U	3.0 U	3.0 U	3.0 U	3.0 U
ZINC	3.0 U	19.6 J	10.3 J	47.6	29.6	334	27.7
RADIONUCLIDES (PC/L)							
GROSS ALPHA		0.7 +/- 2.10	2.5 +/- 2.30				
GROSS BETA		6.9 +/- 3.10	11.0 +/- 3.20				
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3				148		32	

TABLE 7-9
SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WSW7	2WSW7	2WSW8	2WSW9			
LOCATION:	2WSW7	2WSW7	2WSW8	2WSW9			
SAMPLE DATE:	12/05/93	12/05/93	12/02/93	12/02/93	//	//	//
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1			
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered			
VOLATILES (UG/L)							
TETRACHLOROETHENE	10 U		10 U	10 U			
INORGANICS (UG/L)							
ALUMINUM	117 U	136 U	93.9	71.7 J			
ARSENIC	2.0 U	2.0 U	2.0 U	2.0 U			
BARIUM	8.0 U	8.0 U	20.0 U	19.0 U			
BORON	50.0 U	50.0 U	50.0 U	50.0 U			
CADMIUM	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ			
CALCIUM	272 J	256 J	9350	8900			
CHROMIUM	3.0 UJ	3.0 UJ	3.0 U	3.0 U			
COBALT	5.0 UJ	5.0 UJ	5.0 U	5.0 U			
COPPER	7.7 J	4.5 J	2.0 UJ	2.0 UJ			
IRON	9.9 UJ	110	11.9 U	5.7 U			
LEAD	1.0 UJ	6.1 J	1.0 R	1.0 R			
MAGNESIUM	94.0 U	103 J	2310	2260			
MANGANESE	6.0 UJ	9.6 J	6.4 U	6.1 U			
MERCURY	0.2 R	0.2 U	0.2 U	0.21 J			
NICKEL	11.0 UJ	11.0 UJ	11.0 U	11.0 U			
POTASSIUM	447 J	542 J	1860	2040			
SODIUM	1150 U	720 U	24200	23200			
VANADIUM	3.0 UJ	3.3 J	3.0 U	3.0 U			
ZINC	9.7 UJ	17.9 UJ	3.0 U	3.3 U			
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3	1 U	1.0 U	32	32			

TABLE 7-10
SUMMARY OF SURFACE WATER ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Phase I (1)			Phase II - Round 1 (2)					
	Unfiltered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)									
Tetrachloroethene	0/2	-	ND (3)	1/9	2	2WSW12	-	-	NA (4)
SEMIVOLATILE ORGANICS (ug/L)									
Diethyl phthalate	1/2	3.5	2WSW2	0/1	-	ND	-	-	NA
INORGANICS (ug/L)									
Aluminum	2/2	125.6-137	2WSW1	8/9	66.9-20900	2WSW1	5/6	86.3-259	2WSW6
Arsenic	0/2	-	ND	3/9	2.8-2.9	2WSW1	0/6	-	ND
Barium	2/2	22.3-25	2WSW2	2/9	97.6-115	2WSW2	2/6	83.3-91.2	2WSW2
Boron	0/0	-	R (5)	5/9	121-369	2WSW2	4/6	75.9-222	2WSW6
Cadmium	2/2	13.7-66.55	2WSW2	0/9	-	ND	0/6	-	ND
Calcium	2/2	7890-10950	2WSW2	9/9	272-46500	2WSW12	6/6	256-45300	2WSW12
Chromium	1/2	6.8	2WSW1	0/9	-	ND	0/6	-	ND
Cobalt	0/2	-	ND	2/9	63.9-66.8	2WSW6	0/6	-	ND
Copper	2/2	11.45-13	2WSW1	3/9	6.1-29.3	2WSW1	1/6	4.5	2WSW7
Iron	2/2	293-3415	2WSW2	6/9	1070-11300	2WSW12	6/6	110-19400	2WSW12
Lead	2/2	1.5-7.8	2WSW1	4/5	2-5	2WSW6	2/5	1.8-6.1	2WSW7
Magnesium	2/2	2070-4635	2WSW2	8/9	443-18500	2WSW1	6/6	103-10800	2WSW2
Manganese	2/2	52-131	2WSW2	6/9	43.7-1870	2WSW6	6/6	9.6-571	2WSW12
Mercury	0/2	-	ND	1/7	0.21	2WSW9	1/6	0.22	2WSW12
Nickel	1/2	5.4	2WSW2	3/9	11.1-84.7	2WSW1	0/6	-	ND
Potassium	2/2	4020-8475	2WSW2	9/9	447-15300	2WSW2	6/6	542-14700	2WSW2
Sodium	2/2	22100-62400	2WSW2	7/9	19700-143000	2WSW2	5/6	32300-133000	2WSW2
Vanadium	0/2	-	ND	1/9	4.3	2WSW10	1/6	3.3	2WSW7
Zinc	2/2	14.95-22.8	2WSW1	4/9	47.6-334	2WSW6	3/6	27.7-31.4	2WSW1

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TABLE 7-10
SUMMARY OF SURFACE WATER ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Phase I (1)			Phase II - Round 1 (2)					
	Unfiltered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLANEOUS PARAMETERS (mg/L)									
Hardness as CaCO ₃		-	NA	8/9	16-160	2WSW12	0/1	-	ND

- 1 Includes samples 2WSW1, SWSW2, and 2WSW3 (field duplicate of 2WSW2). Duplicate results are averaged and counted as one sample
- 2 Includes samples 2WSW1, 2WSW2, 2WSW6 through 2WSW12.
- 3 ND - Not Detected.
- 4 NA - Not Analyzed.
- 5 R - Results rejected during data validation.

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	112690-2WSD1(0-0.5)	112690-2WSD10(0-0.5)	112690-2WSD2(0-0.5)	112690-2WSD3(0-0.5)	112690-2WSD4(0-0.5)	112690-2WSD5(0-0.5)	112690-2WSD6(0-0.5)
LOCATION:	2WSD1	2WSD1	2WSD2	2WSD3	2WSD4	2WSD5	2WSD6
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE

VOLATILES (UG/KG)

2-BUTANONE	140 J	42 J	100	110 U	20 U	11 U	86 U
ACETONE	210	300	130	230	20 U	11 U	240
CARBON DISULFIDE	11	17	16	18 J	10 U	5 U	9 J
CHLOROBENZENE	11 U	11 U	10 U	54 U	10 U	5 U	43 U
METHYLENE CHLORIDE	11 U	11 U	10 U	54 U	10 J	3 J	10 J
TETRACHLOROETHENE	11 U	11 U	10 U	54 U	16 J	4 J	10 J
TOLUENE	11 U	11 U	10 U	54 U	10 U	5 U	43 U
TRICHLOROETHENE	11 U	11 U	10 U	54 U	11 J	3 J	43 U
XYLENES, TOTAL	11 U	11 U	10 U	54 U	10 U	5 U	43 U

SEMIVOLATILES (UG/KG)

1,4-DICHLOROBENZENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
2,4-DIMETHYLPHENOL	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
2-METHYLNAPHTHALENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
4-METHYLPHENOL	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
ACENAPHTHENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
ACENAPHTHYLENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
ANTHRACENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BENZO(A)ANTHRACENE	670 J	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BENZO(A)PYRENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BENZO(B)FLUORANTHENE	380 J	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BENZO(G,H,I)PERYLENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BENZO(K)FLUORANTHENE	480 J	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BENZOIC ACID	17000 U	18000 U	16000 U	17000 U	16000 U	8700 U	14000 U
BIS(2-ETHYLHEXYL)PHTHALATE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
BUTYL BENZYL PHTHALATE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
CHRYSENE	630 J	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
DI-N-BUTYL PHTHALATE	3500 U	3700 U	6100 U	3600 U	3400 U	1800 U	2800 U
DIBENZO(A,H)ANTHRACENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
DIBENZOFURAN	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
FLUORANTHENE	970 J	3700 U	3400 U	390 J	410 J	1800 U	2800 U
FLUORENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U

TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	112690-2WSD1(0-0.5)	112690-2WSD10(0-0.5)	112690-2WSD2(0-0.5)	112690-2WSD3(0-0.5)	112690-2WSD4(0-0.5)	112690-2WSD5(0-0.5)	112690-2WSD6(0-0.5)
LOCATION:	2WSD1	2WSD1	2WSD2	2WSD3	2WSD4	2WSD5	2WSD6
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE

SEMIVOLATILES (UG/KG)

INDENO(1,2,3-CD)PYRENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
NAPHTHALENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
PENTACHLOROPHENOL	17000 U	18000 U	16000 U	17000 U	16000 U	8700 U	14000 U
PHENANTHRENE	3500 U	3700 U	3400 U	3600 U	3400 U	1800 U	2800 U
PYRENE	1300 J	3700 U	3400 U	670 J	460 J	1800 U	470 J

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	140 J		33 UJ	35 UJ	33 UJ	17 UJ	28 UJ
4,4'-DDE	36 J		40 J	35 UJ	33 UJ	17 UJ	28 UJ
4,4'-DDT	34 UJ		33 UJ	57 J	33 UJ	17 UJ	28 UJ
ALDRIN	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
ALPHA-CHLORDANE	170 UJ		160 UJ	170 UJ	160 UJ	87 UJ	140 UJ
AROCLOR-1260	340 UJ		330 UJ	350 UJ	330 UJ	170 UJ	280 UJ
BETA-BHC	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
DELTA-BHC	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
DIELDRIN	34 UJ		33 UJ	35 UJ	33 UJ	17 UJ	28 UJ
ENDOSULFAN II	34 UJ		33 UJ	35 UJ	33 UJ	17 UJ	28 UJ
ENDOSULFAN SULFATE	34 UJ		33 UJ	35 UJ	33 UJ	17 UJ	28 UJ
ENDOSULFAN-I	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
ENDRIN	34 UJ		33 UJ	35 UJ	33 UJ	17 UJ	28 UJ
ENDRIN KETONE	34 UJ		33 UJ	35 UJ	33 UJ	17 UJ	28 UJ
GAMMA-BHC (LINDANE)	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
GAMMA-CHLORDANE	170 UJ		160 UJ	170 UJ	160 UJ	87 UJ	140 UJ
HEPTACHLOR	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
HEPTACHLOR EPOXIDE	17 UJ		16 UJ	17 UJ	16 UJ	8.7 UJ	14 UJ
METHOXYCHLOR	170 UJ		160 UJ	170 UJ	160 UJ	87 UJ	140 UJ

INORGANICS (MG/KG)

ALUMINUM	18900	18400	22200	18800	16600	14200	19300
ANTIMONY	10.8 UR	11.3 UR	10.1 UR	9.8 UR	8.2 UR	8.2 UR	10.1 UR
ARSENIC	9.2 J	10.2 J	9.5 J	9.5 J	10.0 J	8.5 J	10.5 J
BARIUM	55.6	54.6	64.6	56.6	56.0	53.6	59.9
BERYLLIUM	0.91	0.83	1.1	0.88	0.44	0.39	0.81

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TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	112690-2WSD1(0-0.5)	112690-2WSD10(0-0.5)	112690-2WSD2(0-0.5)	112690-2WSD3(0-0.5)	112690-2WSD4(0-0.5)	112690-2WSD5(0-0.5)	112690-2WSD6(0-0.5)
LOCATION:	2WSD1	2WSD1	2WSD2	2WSD3	2WSD4	2WSD5	2WSD6
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90	11/26/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE

INORGANICS (MG/KG)

	4100 R	4500 R	4000 R	4400 R	1200 R	1300 R	730 R
BORON	4.2	4.8	4.8	5.3	3.8	3.7	3.5
CADMIUM	4670	4660	4930	4220	1480	1090 J	2090
CALCIUM	57.1	74.4	48.9	92.6	73.9	71.7	93.5
CHROMIUM	10.8	10.6	11.9	11.1	7.3	6.8	8.4
COBALT	33.0 J	49.2 J	30.5 J	69.5 J	44.8 J	52.2 J	51.3 J
COPPER	2.7 U	2.8 U	2.6 U	2.4 U	2.0 U	2.0 U	2.5 U
CYANIDE	28100	29200	31700	29700	26700	28300	22900
IRON	51.0	60.6	21.3 J	46.1	56.8	48.1	69.0
LEAD	7630	7800	7870	7990	5950	5550	6700
MAGNESIUM	352	366	365	341	193	166	210
MANGANESE	0.21 UJ	0.28 J	0.19 UJ	0.31 J	0.25 J	0.35 J	0.32 J
MERCURY	26.0	26.4	28.2	27.0	17.8	16.7	19.9
NICKEL	4390	4200	4920	4280	4560	4160	3980
POTASSIUM	0.89	0.88	1.6	1.3	0.79	0.98	1.1
SELENIUM	3.0 UJ	3.2 UJ	2.8 UJ	2.7 UJ	2.3 UJ	2.3 UJ	2.8 UJ
SILVER	3510	3690	3290	6090	383 J	291 J	1150 J
SODIUM	44.5	43.7	49.3	45.5	45.4	44.6	49.3
VANADIUM	90.6	110	126	127	63.2 J	58.1 J	57.6 J
ZINC							

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TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	112690-2WSD7(0-0.5)	112690-2WSD8(0-0.5)	112690-2WSD9(0-0.5)	2WSD10(FIELD)	2WSD11(FIELD)	2WSD12(FIELD)	2WSD13(FIELD)
LOCATION:	2WSD7	2WSD8	2WSD9	2WSD10	2WSD11	2WSD12	2WSD13
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/18/93	11/18/93	11/17/93	11/18/93
INVESTIGATION:	PH1	PH1	PH1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	COMPOSITE	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB

VOLATILES (UG/KG)

2-BUTANONE	110 U	20 U	40 U				
ACETONE	720	190	40 U				
CARBON DISULFIDE	56 U	15	20 U				
CHLOROBENZENE	56 U	10 U	20 U				
METHYLENE CHLORIDE	56 U	2 J	5 J				
TETRACHLOROETHENE	56 U	10 U	11 J				
TOLUENE	56 U	10 U	20 U				
TRICHLOROETHENE	56 U	10 U	6 J				
XYLENES, TOTAL	56 U	10 U	20 U				

SEMIVOLATILES (UG/KG)

1,4-DICHLOROBENZENE	3700 U	3300 U	6600 U				
2,4-DIMETHYLPHENOL	3700 U	3300 U	6600 U				
2-METHYLNAPHTHALENE	3700 U	3300 U	6600 U				
4-METHYLPHENOL	3700 U	3300 U	6600 U				
ACENAPHTHENE	3700 U	3300 U	6600 U				
ACENAPHTHYLENE	3700 U	3300 U	6600 U				
ANTHRACENE	3700 U	3300 U	2400 J				
BENZO(A)ANTHRACENE	3700 U	3300 U	27000				
BENZO(A)PYRENE	3700 U	3300 U	35000				
BENZO(B)FLUORANTHENE	3700 U	420 J	55000				
BENZO(G,H,I)PERYLENE	3700 U	3300 U	23000				
BENZO(K)FLUORANTHENE	3700 U	670 J	45000				
BENZOIC ACID	780 J	16000 U	32000 J				
BIS(2-ETHYLHEXYL)PHTHALATE	3700 U	3300 U	6600 U				
BUTYL BENZYL PHTHALATE	3700 U	3300 U	6600 U				
CHRYSENE	3700 U	610 J	42000				
DI-N-BUTYL PHTHALATE	3700 U	3300 U	7900 U				
DIBENZO(A,H)ANTHRACENE	3700 U	3300 U	6600 U				
DIBENZOFURAN	3700 U	3300 U	1000 J				
FLUORANTHENE	470 J	1300 J	80000				
FLUORENE	3700 U	3300 U	1000 J				
INDENO(1,2,3-CD)PYRENE	3700 U	3300 U	23000				

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TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	112690-2WSD7(0-0.5)	112690-2WSD8(0-0.5)	112690-2WSD9(0-0.5)	2WSD10(FIELD)	2WSD11(FIELD)	2WSD12(FIELD)	2WSD13(FIELD)
LOCATION:	2WSD7	2WSD8	2WSD9	2WSD10	2WSD11	2WSD12	2WSD13
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/18/93	11/18/93	11/17/93	11/18/93
INVESTIGATION:	PH1	PH1	PH1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	COMPOSITE	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB

SEMIVOLATILES (UG/KG)

NAPHTHALENE	3700 U	3300 U	6600 U				
PENTACHLOROPHENOL	18000 U	16000 U	32000 U				
PHENANTHRENE	3700 U	440 J	36000				
PYRENE	610 J	1500 J	42000 J				

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	36 UJ	32 UJ	64 UJ	29.25 U	35.13 U	35.33 U	29.79 U
4,4'-DDE	36 UJ	32 UJ	64 UJ	29.25 U	35.13 U	35.33 U	29.79 U
4,4'-DDT	36 UJ	32 UJ	64 UJ	29.25 U	35.13 U	35.33 U	29.79 U
ALDRIN	18 UJ	16 UJ	32 UJ				
ALPHA-CHLORDANE	180 UJ	160 UJ	320 UJ				
AROCLOR-1260	360 UJ	320 UJ	640 UJ				
BETA-BHC	18 UJ	16 UJ	32 UJ				
DELTA-BHC	18 UJ	16 UJ	32 UJ				
DIELDRIN	36 UJ	32 UJ	64 UJ	29.25 U	35.13 U	35.33 U	29.79 U
ENDOSULFAN II	36 UJ	32 UJ	64 UJ				
ENDOSULFAN SULFATE	36 UJ	32 UJ	64 UJ				
ENDOSULFAN-I	18 UJ	16 UJ	32 UJ				
ENDRIN	36 UJ	32 UJ	64 UJ				
ENDRIN KETONE	36 UJ	32 UJ	64 UJ				
GAMMA-BHC (LINDANE)	18 UJ	16 UJ	32 UJ				
GAMMA-CHLORDANE	180 UJ	160 UJ	320 UJ				
HEPTACHLOR	18 UJ	16 UJ	32 UJ				
HEPTACHLOR EPOXIDE	18 UJ	16 UJ	32 UJ				
METHOXYCHLOR	180 UJ	160 UJ	320 UJ				

INORGANICS (MG/KG)

ALUMINUM	17800	18300	20800				
ANTIMONY	9.4 UR	10.1 UR	9.9 UR				
ARSENIC	13.9 J	8.1 J	11.8 J				
BARIUM	59.7	64.0	72.8				
BERYLLIUM	0.51	0.84	0.85				
BORON	450 R	3600 R	490 R				
CADMIUM	3.5	5.0	6.1				

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TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	112690-2WSD7(0-0.5)	112690-2WSD8(0-0.5)	112690-2WSD9(0-0.5)	2WSD10(FIELD)	2WSD11(FIELD)	2WSD12(FIELD)	2WSD13(FIELD)
LOCATION:	2WSD7	2WSD8	2WSD9	2WSD10	2WSD11	2WSD12	2WSD13
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/18/93	11/18/93	11/17/93	11/18/93
INVESTIGATION:	PH1	PH1	PH1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	COMPOSITE	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB

INORGANICS (MG/KG)

CALCIUM	1830	6800	2160				
CHROMIUM	69.3	95.7	63.7				
COBALT	7.6	10.2	8.6				
COPPER	34.6 J	71.5	39.6 J				
CYANIDE	2.4 U	2.5 U	3.2				
IRON	24100	25500	44000				
LEAD	37.8	69.2	241 J				
MAGNESIUM	6060	7300	5880				
MANGANESE	193	278	357				
MERCURY	0.42 J	0.48 J	0.24 J				
NICKEL	17.6	24.2	21.2				
POTASSIUM	3790	4070	3310				
SELENIUM	1.6	1.2	1.3				
SILVER	2.6 UJ	2.8 UJ	2.8 UJ				
SODIUM	464 J	6650	321 J				
VANADIUM	44.8	41.0	55.9				
ZINC	51.5 J	124	109				

TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WSD14	2WSD14(FIELD)	2WSD15(FIELD)	2WSD16(FIELD)	2WSD17(FIELD)	2WSD18(FIELD)	2WSD19(FIELD)
LOCATION:	2WSD14	2WSD14	2WSD15	2WSD16	2WSD17	2WSD18	2WSD19
SAMPLE DATE:	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93	11/17/93	11/18/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	4.9 UJ	28.5 U	27.03 U	23.36 U	26.45 U	36.95 U	27.16 U
4,4'-DDE	4.9 UJ	28.5 U	27.03 U	23.36 U	26.45 U	36.95 U	27.16 U
4,4'-DDT	4.9 UJ	28.5 U	27.03 U	23.36 U	26.45 U	36.95 U	27.16 U
ALDRIN	2.5 UJ						
ALPHA-CHLORDANE	2.5 UJ						
BETA-BHC	2.5 UJ						
DELTA-BHC	2.5 UJ						
DIELDRIN	4.9 UJ	28.5 U	27.03 U	23.36 U	26.45 U	36.95 U	27.16 U
ENDOSULFAN II	4.9 UJ						
ENDOSULFAN SULFATE	4.9 UJ						
ENDOSULFAN-I	2.5 UJ						
ENDRIN	4.9 UJ						
ENDRIN ALDEHYDE	4.9 UJ						
ENDRIN KETONE	4.9 UJ						
GAMMA-BHC (LINDANE)	2.5 UJ						
GAMMA-CHLORDANE	2.5 UJ						
HEPTACHLOR	2.5 UJ						
HEPTACHLOR EPOXIDE	2.5 UJ						
METHOXYCHLOR	2.5 UJ						

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WSD20(FIELD)	2WSD21(FIELD)	2WSD22(FIELD)	2WSD23 (0 0-1 0)	2WSD24 (0 0-1 0)	2WSD25 (0 0-1 0)	2WSD26 (0 0-1 0)
LOCATION:	2WSD20	2WSD21	2WSD22	2WSD23	2WSD24	2WSD25	2WSD26
SAMPLE DATE:	11/18/93	11/19/93	11/19/93	10/29/93	10/29/93	10/29/93	10/29/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	30.35 U	29.72 U	43.49 U	410 J	3100 J	4800 J	23 U
4,4'-DDE	30.35 U	29.72 U	43.49 U	93	240 J	720 J	6.2 J
4,4'-DDT	30.35 U	29.72 U	43.49 U	190	47 U	2900	6.9 UJ
ALDRIN				7.6 U	24 UJ	25 UJ	3.6 UJ
ALPHA-CHLORDANE				9.5	24 UJ	25 UJ	3.6 UJ
AROCLOR-1260				150 U	470 U	480 U	69 U
BETA-BHC				7.6 U	24 UJ	25 UJ	3.6 UJ
DELTA-BHC				7.6 U	24 UJ	25 UJ	3.6 UJ
DIELDRIN	30.35 U	29.72 U	43.49 U	15 U	47 UJ	48 UJ	6.9 UJ
ENDOSULFAN II				15 U	47 U	48 U	6.9 U
ENDOSULFAN SULFATE				15 U	47 U	48 U	6.9 U
ENDOSULFAN-I				7.6 U	24 UJ	25 UJ	3.6 UJ
ENDRIN				15 U	47 U	48 U	6.9 U
ENDRIN ALDEHYDE				15 U	47 U	48 U	6.9 U
ENDRIN KETONE				15 U	47 U	48 U	6.9 U
GAMMA-BHC (LINDANE)				7.6 U	24 UJ	25 UJ	3.6 UJ
GAMMA-CHLORDANE				6 J	14 J	25 UJ	3.6 UJ
HEPTACHLOR				7.6 U	24 UJ	25 UJ	3.6 UJ
HEPTACHLOR EPOXIDE				7.6 U	24 UJ	25 UJ	3.6 UJ
METHOXYCHLOR				76 U	240 U	250 U	36 U
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON (MG/KG)				65000	91000	28000	26000

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WSD27(FIELD)	2WSD28(FIELD)	2WSD29(FIELD)	2WSD30(FIELD)	2WSD31(FIELD)	2WSD32(FIELD)	2WSD33(FIELD)
LOCATION:	2WSD27	2WSD28	2WSD29	2WSD30	2WSD31	2WSD32	2WSD33
SAMPLE DATE:	11/19/93	11/19/93	11/19/93	11/19/93	11/19/93	11/17/93	11/20/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	26.61 U	25.93 U	24.87 U	34.62 U	47.23 U	36.37 U	32.94 U
4,4'-DDE	26.61 U	25.93 U	24.87 U	34.62 U	47.23 U	36.37 U	32.94 U
4,4'-DDT	26.61 U	25.93 U	24.87 U	34.62 U	47.23 U	36.37 U	32.94 U
DIELDRIN	26.61 U	25.93 U	24.87 U	34.62 U	47.23 U	36.37 U	32.94 U

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WSD34	2WSD34(FIELD)	2WSD35(FIELD)	2WSD36(FIELD)	2WSD37(FIELD)	2WSD38	2WSD38(FIELD)
LOCATION:	2WSD34	2WSD34	2WSD35	2WSD36	2WSD37	2WSD38	2WSD38
SAMPLE DATE:	11/19/93	11/19/93	11/20/93	11/20/93	11/17/93	11/20/93	11/20/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	5.9 UJ	29.5 U	35.7 U	37.63 U	29.01 U	6.9 U	29.7 U
4,4'-DDE	5.9 UJ	29.5 U	35.7 U	37.63 U	29.01 U	6.9 U	29.7 U
4,4'-DDT	13 J	29.5 U	35.7 U	37.63 U	29.01 U	6.9 U	29.7 U
ALDRIN	3 UJ					3.5 U	
ALPHA-CHLORDANE	3 UJ					3.5 U	
BETA-BHC	3 UJ					3.5 U	
DELTA-BHC	3 UJ					3.5 U	
DIELDRIN	5.9 UJ	29.5 U	35.7 U	37.63 U	29.01 U	6.9 U	29.7 U
ENDOSULFAN II	5.9 UJ					6.9 U	
ENDOSULFAN SULFATE	5.9 UJ					6.9 U	
ENDOSULFAN-I	3 UJ					3.5 U	
ENDRIN	5.9 UJ					6.9 U	
ENDRIN ALDEHYDE	5.9 UJ					6.9 U	
ENDRIN KETONE	5.9 UJ					6.9 U	
GAMMA-BHC (LINDANE)	3 UJ					3.5 U	
GAMMA-CHLORDANE	3 UJ					3.5 U	
HEPTACHLOR	3.1 J					3.5 U	
HEPTACHLOR EPOXIDE	3 UJ					3.5 U	
METHOXYCHLOR	30 UJ					35 U	

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WSD39	2WSD39(FIELD)	2WSD40	2WSD40(FIELD)	2WSD41	2WSD41(FIELD)	2WSD42
LOCATION:	2WSD39	2WSD39	2WSD40	2WSD40	2WSD41	2WSD41	2WSD42
SAMPLE DATE:	11/20/93	11/20/93	11/20/93	11/20/93	11/20/93	11/20/93	11/17/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	7.3 U	30.8 U	7.5 UJ	32.4 U	12 J	19.3 U	
4,4'-DDE	7.3 U	30.8 U	7.5 UJ	32.4 U	3.8 U	19.3 U	
4,4'-DDT	7.3 U	30.8 U	7.5 UJ	32.4 U	8	19.3 U	
ALDRIN	3.8 U		3.9 UJ		2 U		
ALPHA-CHLORDANE	3.8 U		3.9 UJ		2 U		
BETA-BHC	3.8 U		3.9 UJ		2 U		
DELTA-BHC	3.8 U		3.9 UJ		2 U		
DIELDRIN	7.3 U	30.8 U	7.5 UJ	32.4 U	3.8 U	19.3 U	
ENDOSULFAN II	7.3 U		7.5 UJ		3.8 U		
ENDOSULFAN SULFATE	7.3 U		7.5 UJ		3.8 U		
ENDOSULFAN-I	3.8 U		3.9 UJ		2 U		
ENDRIN	7.3 U		7.5 UJ		3.8 U		
ENDRIN ALDEHYDE	7.3 U		7.5 UJ		3.8 U		
ENDRIN KETONE	7.3 U		7.5 UJ		3.8 U		
GAMMA-BHC (LINDANE)	3.8 U		3.9 UJ		2 U		
GAMMA-CHLORDANE	3.8 U		3.9 UJ		2 U		
HEPTACHLOR	3.8 U		3.9 UJ		2 U		
HEPTACHLOR EPOXIDE	3.8 U		3.9 UJ		2 U		
METHOXYCHLOR	3.8 U		3.9 UJ		20 U		
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON (MG/KG)	14000						

TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WSD42(FIELD)	T1-A	T1-B	T10-A	T10-B	T2-A	DUP-03
LOCATION:	2WSD42	T1-A	T1-B	T10-A	T10-B	T2-A	T2-A
SAMPLE DATE:	11/17/93	11/28/94	11/28/94	11/30/94	11/30/94	11/28/94	11/28/94
INVESTIGATION:	PH2-1	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB

VOLATILES (UG/KG)

2-BUTANONE		12 U	11 U	14 U	21 U	520	420
ACETONE		12 U	11 U	25 U	67 U	49 U	85 U
CARBON DISULFIDE		12 U	11 U	14 U	12 J	16 U	15 U
CHLOROBENZENE		12 U	11 U	14 U	22 U	16 U	2 J
METHYLENE CHLORIDE		12 U	12 U	14 U	32 U	16 U	19 U
TETRACHLOROETHENE		12 U	11 U	14 U	22 U	16 U	15 UJ
TOLUENE		12 U	11 U	3 J	22 U	5 J	2 J
TRICHLOROETHENE		12 U	11 U	14 U	22 U	16 U	15 U
XYLENES, TOTAL		12 U	11 U	14 U	22 UJ	16 U	15 UJ

SEMIVOLATILES (UG/KG)

1,4-DICHLOROBENZENE		410 U	380 U	470 U	730 U	520 U	480 U
2,4-DIMETHYLPHENOL		410 U	380 UJ	470 U	730 U	520 U	480 UJ
2-METHYLNAPHTHALENE		410 U	380 UJ	40 J	730 U	520 U	480 UJ
4-METHYLPHENOL		410 U	380 U	470 U	730 U	520 U	480 U
ACENAPHTHENE		410 U	380 UJ	110 J	730 U	30 J	91 J
ACENAPHTHYLENE		410 U	380 UJ	470 U	730 U	520 U	480 UJ
ANTHRACENE		410 U	40 J	48 J	730 U	71 J	200 J
BENZO(A)ANTHRACENE		45 J	180 J	290 J	90 J	260 J	680 J
BENZO(A)PYRENE		55 J	190 J	320 J	110 J	290 J	690 J
BENZO(B)FLUORANTHENE		54 J	220 J	270 J	110 J	310 J	660 J
BENZO(G,H,I)PERYLENE		50 J	160 J	290 J	730 U	230 J	630 J
BENZO(K)FLUORANTHENE		62 J	150 J	300 J	120 J	220 J	520 J
BENZOIC ACID		2100 U	2000 U	2500 U	3800 U	2600 U	2500 U
BIS(2-ETHYLHEXYL)PHTHALATE		410 U	380 U	470 U	3500 J	520 U	480 U
BUTYL BENZYL PHTHALATE		410 U	380 U	36 J	730 U	520 U	480 U
CARBAZOLE		410 U	380 U	470 U	730 U	32 J	480 U
CHRYSENE		65 J	220 J	360 J	110 J	340 J	780 J
DI-N-BUTYL PHTHALATE		410 U	380 U	470 U	730 U	520 U	31 J
DIBENZO(A,H)ANTHRACENE		410 U	380 U	470 U	730 U	100 J	310 J
DIBENZOFURAN		410 U	380 UJ	62 J	730 U	520 U	44 J
FLUORANTHENE		110 J	240 J	490	100 J	490 J	1000 J
FLUORENE		410 U	380 UJ	83 J	730 U	37 J	95 J

TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WSD42(FIELD)	T1-A	T1-B	T10-A	T10-B	T2-A	DUP-03
LOCATION:	2WSD42	T1-A	T1-B	T10-A	T10-B	T2-A	T2-A
SAMPLE DATE:	11/17/93	11/28/94	11/28/94	11/30/94	11/30/94	11/28/94	11/28/94
INVESTIGATION:	PH2-1	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB

SEMIVOLATILES (UG/KG)

INDENO(1,2,3-CD)PYRENE		41 J	140 J	260 J	86 J	200 J	550 J
NAPHTHALENE		410 U	380 UJ	73 J	730 U	520 U	480 UJ
PENTACHLOROPHENOL		1000 U	240 J	1100 U	1800 U	1200 U	1200 U
PHENANTHRENE		43 J	190 J	280 J	79 J	260 J	920 J
PYRENE		96 J	470	720	320 J	560 J	2000 J

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	19.51 U	9 J	12 R	190 J	35 J	650 J	250 J
4,4'-DDE	19.51 U	4.1 U	3.8 U	23 J	7.4 J	30 J	13 J
4,4'-DDT	19.51 U	15 R	45	85 J	7.3 UR	44	60 J
ALDRIN		2.1 U	2 U	2.4 UJ	3.8 UJ	2.7 U	2.5 U
ALPHA-CHLORDANE		4.8 J	2.9 J	5.5 J	3.8 U	2.7 U	2.5 U
AROCLOR-1260		150 J	180	47 U	73 U	52 U	49 U
BETA-BHC		2.1 U	2 U	2.4 UJ	3.8 UJ	2.7 U	2.5 U
DELTA-BHC		2.1 U	2 U	2.4 U	3.8 U	2.7 U	2.5 U
DIELDRIN	19.51 U	4.1 U	3.8 U	4.7 U	7.3 U	5.2 U	4.9 U
ENDOSULFAN II		4.1 U	3.8 U	4.7 U	7.3 U	31 J	4.9 UJ
ENDOSULFAN SULFATE		4.1 U	3.8 U	4.7 U	7.3 U	5.2 U	4.9 U
ENDOSULFAN-I		2.4 J	2.1 J	4.8 J	3.8 U	2.7 U	2.5 U
ENDRIN		4.1 U	3.8 U	4.7 U	7.3 U	5.2 U	4.9 U
ENDRIN ALDEHYDE		4.1 U	5.6 J	4.7 U	7.3 U	16 J	4.9 UJ
ENDRIN KETONE		4.1 U	3.8 U	4.7 U	7.3 U	5.2 U	4.9 U
GAMMA-BHC (LINDANE)		2.1 U	2 U	2.4 UJ	3.8 UJ	2.7 U	2.5 U
GAMMA-CHLORDANE		5.7 J	3.7 J	4.5 J	3.8 U	4.8 J	2.5 UJ
HEPTACHLOR		2.8 J	2 U	2.4 U	3.8 U	2.7 U	2.5 U
HEPTACHLOR EPOXIDE		3.7 J	4.5	2.4 U	3.8 U	2.7 U	2.5 U
METHOXYCHLOR		21 U	20 U	24 UJ	38 UJ	27 U	25 U

INORGANICS (MG/KG)

ALUMINUM		3530	4240	6700	12800	4470	4700
ANTIMONY		0.48 J	0.48 UJ	0.56 U	0.81 U	0.72 J	0.62 UJ
ARSENIC		1.9	1.6	3.4	9.1	2.5	2.5
BARIUM		27.9	33.9	57.0	42.9	46.7	56.5
BERYLLIUM		0.23	0.24	0.24 J	0.62	0.48	0.7

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TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WSD42(FIELD)	T1-A	T1-B	T10-A	T10-B	T2-A	DUP-03
LOCATION:	2WSD42	T1-A	T1-B	T10-A	T10-B	T2-A	T2-A
SAMPLE DATE:	11/17/93	11/28/94	11/28/94	11/30/94	11/30/94	11/28/94	11/28/94
INVESTIGATION:	PH2-1	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
INORGANICS (MG/KG)							
BORON		0.35 U	0.36 U	2.1 U	29.5	2.2 U	7.6 U
CADMIUM		0.29	0.12 J	0.37	0.34 J	0.29	0.46
CALCIUM		1130	1240	1650	3330	1510	1510
CHROMIUM		8.1	9.6	15.4	39.9	15.2	16.9
COBALT		3.6	4.3	3.9	7.7	6.8	8.4
COPPER		79.6	45.5	31.4	18.8	104	101
CYANIDE				0.7 UJ	1.0 UJ		
IRON		5980	7740	12400	27500	10300	15600
LEAD		23.9	28.7	71.3	16.1	123	142
MAGNESIUM		1750	2120	2770	7340	1940	2000
MANGANESE		132	125	121	323	78.8	99.7
MERCURY		0.12 UR	0.36 J	0.28 U	0.28 U	0.17 J	0.24 J
NICKEL		6.6 J	9.1 J	12.7	20.8	61.5 J	53.0 J
POTASSIUM		890	1080	1630 J	3770 J	1120	1070
SELENIUM		0.58 UJ	0.6 UJ	0.7 U	1.5 J	0.68 UJ	0.77 UJ
SILVER		0.37	0.73	0.14 U	0.2 U	0.17 J	0.22
SODIUM		114	215	253	3870	512	556
VANADIUM		17.2 J	13.2 J	38.7	39.1	161 J	183 J
ZINC		63.6 J	100 J	133 J	66.5 J	225 J	378 J
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON (MG/KG)		32100	24500	52400	68300		47500

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	T2-B	T3-A	T3-B	T4-A	T4-B	T5-A	T5-B
LOCATION:	T2-B	T3-A	T3-B	T4-A	T4-B	T5-A	T5-B
SAMPLE DATE:	11/28/94	11/28/94	11/28/94	11/29/94	11/29/94	11/29/94	11/29/94
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
VOLATILES (UG/KG)							
2-BUTANONE	32 U	12 U	15 U	12 U	12 U	17 U	12 U
ACETONE	53 U	12 U	18 U	12 U	12 U	30 U	12 U
CARBON DISULFIDE	17 U	12 U	15 U	12 U	12 U	14 U	12 U
CHLOROBENZENE	17 U	12 U	15 U	12 U	12 U	14 U	12 U
METHYLENE CHLORIDE	17 U	12 U	19 U	24 U	35 U	39 U	29 U
TETRACHLOROETHENE	17 U	12 U	15 U	12 U	12 U	14 U	12 U
TOLUENE	17 U	12 U	3 J	12 U	12 U	14 U	12 U
TRICHLOROETHENE	17 U	12 U	15 U	12 U	12 U	14 U	12 U
XYLENES, TOTAL	17 U	12 U	15 U	12 U	12 U	14 U	12 U
SEMIVOLATILES (UG/KG)							
1,4-DICHLOROBENZENE	550 U	390 U	500 U	380 U	400 U	480 U	380 U
2,4-DIMETHYLPHENOL	550 U	390 U	500 U	380 U	400 U	480 U	380 U
2-METHYLNAPHTHALENE	550 U	55 J	500 U	380 U	400 U	480 U	380 U
4-METHYLPHENOL	550 U	390 U	500 U	380 U	400 U	480 U	380 U
ACENAPHTHENE	550 U	58 J	500 U	380 U	400 U	220 J	380 U
ACENAPHTHYLENE	550 U	390	70 J	380 U	400 U	34 J	380 U
ANTHRACENE	58 J	450	90 J	45 J	400 U	43 J	380 U
BENZO(A)ANTHRACENE	260 J	3000	480 J	120 J	77 J	180 J	25 J
BENZO(A)PYRENE	300 J	2600	480 J	130 J	74 J	220 J	30 J
BENZO(B)FLUORANTHENE	550 U	390 U	420 J	130 J	85 J	210 J	44 J
BENZO(G,H,I)PERYLENE	240 J	1100	320 J	100 J	66 J	230 J	27 J
BENZO(K)FLUORANTHENE	440 J	3700	510	130 J	75 J	270 J	380 U
BENZOIC ACID	2800 U	2000 U	2600 U	1800 U	2000 U	2400 U	2000 U
BIS(2-ETHYLHEXYL)PHTHALATE	550 U	400 U	500 U	380 U	400 U	480 U	380 U
BUTYL BENZYL PHTHALATE	550 U	390 U	61 J	21 J	400 U	480 U	380 U
CARBAZOLE	550 U	57 J	32 J	25 J	400 U	130 J	380 U
CHRYSENE	350 J	3700	590	150 J	90 J	280 J	38 J
DI-N-BUTYL PHTHALATE	550 U	390 U	63 J	26 J	23 J	44 J	26 J
DIBENZO(A,H)ANTHRACENE	87 J	390 U	170 J	380 U	400 U	480 U	380 U
DIBENZOFURAN	550 U	35 J	500 U	380 U	400 U	72 J	380 U
FLUORANTHENE	450 J	4200	890	260 J	180 J	520	56 J
FLUORENE	550 U	160 J	38 J	21 J	400 U	29 J	380 U

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TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	T2-B	T3-A	T3-B	T4-A	T4-B	T5-A	T5-B
LOCATION:	T2-B	T3-A	T3-B	T4-A	T4-B	T5-A	T5-B
SAMPLE DATE:	11/28/94	11/28/94	11/28/94	11/29/94	11/29/94	11/29/94	11/29/94
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
SEMIVOLATILES (UG/KG)							
INDENO(1,2,3-CD)PYRENE	200 J	1000	300 J	92 J	57 J	180 J	22 J
NAPHTHALENE	550 U	56 J	500 U	380 U	400 U	76 J	380 U
PENTACHLOROPHENOL	1300 U	950 U	1200 U	930 U	960 U	1200 U	930 U
PHENANTHRENE	230 J	1800	320 J	180 J	93 J	240 J	22 J
PYRENE	620	4600	910	220 J	150 J	440 J	46 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	210 J	390	1400	3.8 U	4.5 J	1300	3.8 U
4,4'-DDE	19 J	260	330	3.8 U	4 U	57 J	3.8 U
4,4'-DDT	88 J	890	2900	3.8 U	4 U	380	4.4 J
ALDRIN	2.8 U	20 U	26 U	2 U	2 U	3.2 J	2 U
ALPHA-CHLORDANE	7.6	4.4 J	12 J	2 U	2 U	13	2 U
AROCLOR-1260	55 U	390 U	500 U	38 U	40 U	240 U	38 U
BETA-BHC	2.8 U	20 U	26 U	2 UJ	2 UJ	2.7 J	2 UJ
DELTA-BHC	2.8 U	20 U	26 U	2 U	2 U	4.2 J	2 U
DIELDRIN	5.5 U	39 U	50 U	3.8 U	4 U	8.4 J	3.8 U
ENDOSULFAN II	6.9 J	39 U	50 U	3.8 U	4 U	24 U	3.8 U
ENDOSULFAN SULFATE	5.5 U	14 J	50 U	3.8 U	4 U	6.9 J	3.8 U
ENDOSULFAN-I	2.8 U	11 J	26 U	2 U	2 U	12 U	2 U
ENDRIN	5.5 U	39 U	50 U	3.8 U	4 U	16 J	3.8 U
ENDRIN ALDEHYDE	5.5 U	39 U	16 J	3.8 UJ	4 UJ	10 J	3.8 UJ
ENDRIN KETONE	5.5 U	39 U	50 U	3.8 U	4 U	20 J	3.8 U
GAMMA-BHC (LINDANE)	2.8 U	20 U	26 U	2 U	2 U	3.5 J	2 U
GAMMA-CHLORDANE	5.1	20 U	13 J	2 U	2 U	8.7 J	2 U
HEPTACHLOR	2.8 U	20 U	26 U	2 U	2 U	4.5 J	2 U
HEPTACHLOR EPOXIDE	3.7 J	20 U	26 U	2 U	2 U	2.2 J	2 U
METHOXYCHLOR	28 U	200 U	260 U	20 U	20 U	38 J	20 U
INORGANICS (MG/KG)							
ALUMINUM	6020	3820	5040	3670	2980	5080	2690
ANTIMONY	0.62 UJ	0.53 UJ	0.58 UJ	0.47 UJ	0.47 UJ	0.6 UJ	0.47 UJ
ARSENIC	2.2	3.0	2.6	1.4	1.4	2.1	1.0 J
BARIIUM	73.8	28.8	38.4	29.2	41.1	59.4	11.9
BERYLLIUM	0.32	0.21 J	0.33	0.16 J	0.14 J	0.26 J	0.14 J

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	T2-B	T3-A	T3-B	T4-A	T4-B	T5-A	T5-B
LOCATION:	T2-B	T3-A	T3-B	T4-A	T4-B	T5-A	T5-B
SAMPLE DATE:	11/28/94	11/28/94	11/28/94	11/29/94	11/29/94	11/29/94	11/29/94
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
INORGANICS (MG/KG)							
BORON	0.46 UJ	0.4 U	0.51 U	0.35 U	0.36 U	1.3 U	0.35 U
CADMIUM	0.3	0.26	0.43	0.12 U	0.21 J	0.15 U	0.12 U
CALCIUM	1300	900	868	1060	934	1630	1220
CHROMIUM	19.5	8.6	11.1	8.0	7.0	15.0	7.7
COBALT	5.0	4.4	7.9	3.0	3.2	4.2	3.3
COPPER	44.9	34.5	52.6	14.7	36.7	28.4	19.5
CYANIDE				1.5	0.59 U	0.9 J	0.9 J
IRON	12500	9390	8020	5800	5630	10600	5660
LEAD	42.0	32.1	61.5	26.5	32.4	40.6	16.2
MAGNESIUM	2860	1650	2200	1770	1570	2280	1820
MANGANESE	132	310	99.8	90.1	55.3	101	89.3
MERCURY	0.32 J	0.15 J	0.19 J	0.12 UR	0.12 UR	0.15 UR	0.12 UR
NICKEL	17.0 J	8.6 J	18.9 J	6.7 J	10.3 J	13.8 J	8.5 J
POTASSIUM	1890	813	1100	1120	926	1290	659
SELENIUM	0.77 UJ	0.67 UJ	0.73 UJ	0.59 UJ	0.59 UJ	0.75 UJ	0.58 UJ
SILVER	0.15 U	0.13 U	0.15 U	0.12 U	0.12 U	0.15 U	0.12 U
SODIUM	516	285	1050	250	462	2480	388
VANADIUM	66.4 J	17.0 J	18.5 J	12.8 J	11.2 J	37.4 J	8.9 J
ZINC	95.4 J	87.4 J	284 J	39.2 J	45.1 J	68.2 J	35.0 J
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON (MG/KG)	63400	31100	33500	9960	8420	16900	9410

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TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	T6-A	DUP-5	T6-B	T7-A	T7-B	T8-A	T8-B
LOCATION:	T6-A	T6-A	T6-B	T7-A	T7-B	T8-A	T8-B
SAMPLE DATE:	11/29/94	11/29/94	11/29/94	11/29/94	11/29/94	11/30/94	11/30/94
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
VOLATILES (UG/KG)							
2-BUTANONE	19 UJ	19 U	21 U	37 U	120 UR	27 U	1400
ACETONE	19 U	19 U	40 U	76 U	260 UR	67 U	110 U
CARBON DISULFIDE	19 UJ	19 U	24 U	19 U	67 UR	21 U	22 U
CHLOROBENZENE	19 UJ	19 UJ	3 J	19 U	14 J	21 U	22 U
METHYLENE CHLORIDE	62 U	61 U	74 U	38 U	210 UR	21 U	42 U
TETRACHLOROETHENE	19 UJ	19 UJ	24 UJ	19 U	67 UR	21 U	22 U
TOLUENE	3 J	3 J	24 UJ	5 J	67 UR	21 U	6 J
TRICHLOROETHENE	19 UJ	19 U	24 U	19 U	67 UR	21 U	22 U
XYLENES, TOTAL	19 UJ	19 UJ	3 J	19 U	67 UR	21 U	22 UJ
SEMIVOLATILES (UG/KG)							
1,4-DICHLOROBENZENE	620 U	630 UJ	42 J	620 U	2200 UR	690 U	730 U
2,4-DIMETHYLPHENOL	620 U	630 UJ	800 UJ	620 U	2200 UR	690 U	210 J
2-METHYLNAPHTHALENE	620 U	630 UJ	800 UJ	620 U	2200 UR	49 J	730 U
4-METHYLPHENOL	620 U	630 UJ	800 UJ	620 U	2200 UR	690 U	730 U
ACENAPHTHENE	620 U	630 UJ	110 J	77 J	380 J	35 J	730 U
ACENAPHTHYLENE	52 J	630 UJ	800 UJ	620 U	2200 UR	690 U	730 U
ANTHRACENE	56 J	34 J	800 U	79 J	2200 UR	71 J	38 J
BENZO(A)ANTHRACENE	190 J	280 J	140 J	390 J	240 J	370 J	210 J
BENZO(A)PYRENE	230 J	310 J	160 J	430 J	340 J	340 J	210 J
BENZO(B)FLUORANTHENE	220 J	390 J	240 J	430 J	370 J	370 J	210 J
BENZO(G,H,I)PERYLENE	250 J	420 J	290 J	350 J	340 J	300 J	180 J
BENZO(K)FLUORANTHENE	330 J	240 J	140 J	320 J	270 J	350 J	210 J
BENZOIC ACID	3200 U	3200 U	4100 U	3200 U	11000 UR	3500 U	3800 U
BIS(2-ETHYLHEXYL)PHTHALATE	620 U	630 U	800 U	620 U	4900 UR	690 U	730 U
BUTYL BENZYL PHTHALATE	50 J	630 U	800 U	620 U	390 J	690 U	730 U
CARBAZOLE	43 J	630 UJ	800 U	620 U	2200 UR	690 U	730 U
CHRYSENE	300 J	430 J	230 J	410 J	340 J	490 J	280 J
DI-N-BUTYL PHTHALATE	56 J	34 J	800 U	33 J	2200 UR	690 U	730 U
DIBENZO(A,H)ANTHRACENE	86 J	630 U	800 U	130 J	2200 UR	690 UJ	730 U
DIBENZOFURAN	620 U	630 UJ	68 J	55 J	280 J	40 J	730 U
FLUORANTHENE	500 J	330 J	200 J	650	560 J	520 J	310 J
FLUORENE	620 U	630 UJ	69 J	90 J	340 J	79 J	730 U

TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	T6-A	DUP-5	T6-B	T7-A	T7-B	T8-A	T8-B
LOCATION:	T6-A	T6-A	T6-B	T7-A	T7-B	T8-A	T8-B
SAMPLE DATE:	11/29/94	11/29/94	11/29/94	11/29/94	11/29/94	11/30/94	11/30/94
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
SEMIVOLATILES (UG/KG)							
INDENO(1,2,3-CD)PYRENE	210 J	330 J	220 J	360 J	350 J	260 J	150 J
NAPHTHALENE	620 U	630 UJ	800 UJ	620 U	2200 UR	57 J	730 U
PENTACHLOROPHENOL	1500 U	1500 UJ	2000 U	1500 U	5300 UR	1700 U	1800 U
PHENANTHRENE	200 J	220 J	140 J	350 J	300 J	260 J	180 J
PYRENE	470 J	900 J	370 J	530 J	450 J	1300	630 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	46 R	49 R	410	6.2 U	22 UR	86 J	7.3 UJ
4,4'-DDE	10 J	15 J	38	6.2 U	140 J	19 J	7.3 UJ
4,4'-DDT	55 R	39 R	8 U	6.2 U	23 R	6.9 UR	7.3 UJ
ALDRIN	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 UJ	3.8 UJ
ALPHA-CHLORDANE	29	29	15 J	3.2 U	22 J	3.5 U	3.8 U
AROCLOR-1260	1400	1500	530	82 J	550 J	69 U	73 U
BETA-BHC	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 UJ	3.8 UJ
DELTA-BHC	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 U	3.8 U
DIELDRIN	26	23	8 U	6.2 U	22 UR	6.9 U	7.3 U
ENDOSULFAN II	48 R	50 R	17 R	6.2 U	22 UR	6.9 U	7.3 U
ENDOSULFAN SULFATE	9.7 R	10 R	8 U	6.2 U	22 UR	6.9 U	7.3 U
ENDOSULFAN-I	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 U	3.8 U
ENDRIN	8.2 J	7.8 J	8 U	6.2 U	22 UR	6.9 U	7.3 U
ENDRIN ALDEHYDE	22 R	23 R	8 U	6.2 U	22 UR	6.9 U	7.3 U
ENDRIN KETONE	5.4 R	12 R	8 U	6.2 U	22 UR	6.9 U	7.3 U
GAMMA-BHC (LINDANE)	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 UJ	3.8 UJ
GAMMA-CHLORDANE	21 J	23 J	11 J	3.2 U	11 UR	3.5 U	3.8 U
HEPTACHLOR	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 U	3.8 U
HEPTACHLOR EPOXIDE	3.2 U	3.3 U	4.1 U	3.2 U	11 UR	3.5 U	3.8 U
METHOXYCHLOR	31 R	39 R	41 U	32 U	110 UR	35 UJ	38 UJ
INORGANICS (MG/KG)							
ALUMINUM	15800	14800	9820	7150	27100 J	14200	19900
ANTIMONY	0.85 UJ	0.77 UJ	1.1 J	1.2 J	3.1 UR	0.84 U	0.95 U
ARSENIC	7.2	8.1	4.8	2.5	8.1 J	11.0	14.1
BARIUM	113	120	94.1	124	318 J	53.4	77.9
BERYLLIUM	1.3	1.2	1.3	0.28 J	4.1 J	0.66	0.98

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TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	T6-A	DUP-5	T6-B	T7-A	T7-B	T8-A	T8-B
LOCATION:	T6-A	T6-A	T6-B	T7-A	T7-B	T8-A	T8-B
SAMPLE DATE:	11/29/94	11/29/94	11/29/94	11/29/94	11/29/94	11/30/94	11/30/94
INVESTIGATION:	FFS	FFS	FFS	FFS	FFS	FFS	FFS
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
INORGANICS (MG/KG)							
BORON	0.64 UJ	0.58 UJ	0.77 UJ	0.9 U	2.3 UR	28.7	39.3
CADMIUM	0.72	0.63	0.68	0.23 J	1.6 J	0.41 J	0.47 J
CALCIUM	3290	2960	2230	3350	5330 J	2790	3610
CHROMIUM	44.5	49.8	40.2	13.7	44.3 J	80.3	96.8
COBALT	10.0	9.2	4.7	8.1	13.6 J	8.1	9.6
COPPER	133	114	82.0	33.8	173 J	48.4	64.2
CYANIDE	2.0 J	2.1	1.8 J	1.1 U	6.1 J	1.1 UJ	1.2 UJ
IRON	47500	53100	35700	19200	198000 J	24500	37100
LEAD	141	109	78.4	17.4	110 J	61.2	66.6
MAGNESIUM	5550	4800	2660	4170	3900 J	7230	9150
MANGANESE	285	271	134	154	269 J	240	338
MERCURY	0.21 UR	0.43 J	1.2 J	0.44 J	0.76 UR	0.4 U	0.51 U
NICKEL	29.0 J	26.2 J	15.8 J	12.2 J	47.7 J	21.7	27.8
POTASSIUM	2980	2650	1490	3000	2030 J	3880 J	5170 J
SELENIUM	1.1 UJ	2.2 J	1.3 UJ	1.1 UJ	6.8 J	2.2 J	3.0 J
SILVER	0.96	0.81	0.85	0.22 U	0.86 J	0.33 J	0.47 J
SODIUM	1130	966	725	926	1410 J	2980	3320
VANADIUM	176 J	152 J	120 J	38.2 J	203 J	45.3	59.5
ZINC	213 J	195 J	172 J	76.3 J	702 J	73.0 J	95.5 J
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON (MG/KG)	11200	32600	25000	54800	63000	84100	79600

TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	T9-A	T9-B					
LOCATION:	T9-A	T9-B					
SAMPLE DATE:	11/30/94	11/30/94					
INVESTIGATION:	FFS	FFS					
SAMPLE TYPE:	GRAB	GRAB					
VOLATILES (UG/KG)							
2-BUTANONE	34 U	59					
ACETONE	90 U	21 U					
CARBON DISULFIDE	17 U	3 J					
CHLOROBENZENE	17 UJ	21 U					
METHYLENE CHLORIDE	17 U	21 U					
TETRACHLOROETHENE	17 UJ	21 U					
TOLUENE	17 UJ	21 U					
TRICHLOROETHENE	17 U	21 U					
XYLENES, TOTAL	17 UJ	21 U					
SEMIVOLATILES (UG/KG)							
1,4-DICHLOROBENZENE	570 U	700 U					
2,4-DIMETHYLPHENOL	570 U	700 U					
2-METHYLNAPHTHALENE	51 J	700 U					
4-METHYLPHENOL	43 J	700 U					
ACENAPHTHENE	48 J	700 U					
ACENAPHTHYLENE	570 U	700 U					
ANTHRACENE	34 J	52 J					
BENZO(A)ANTHRACENE	140 J	230 J					
BENZO(A)PYRENE	160 J	260 J					
BENZO(B)FLUORANTHENE	130 J	240 J					
BENZO(G,H,I)PERYLENE	220 J	190 J					
BENZO(K)FLUORANTHENE	140 J	200 J					
BENZOIC ACID	3000 U	3600 U					
BIS(2-ETHYLHEXYL)PHTHALATE	570 U	700 U					
BUTYL BENZYL PHTHALATE	570 UJ	700 U					
CARBAZOLE	570 U	700 U					
CHRYSENE	230 J	260 J					
DI-N-BUTYL PHTHALATE	570 U	700 U					
DIBENZO(A,H)ANTHRACENE	72 J	700 U					
DIBENZOFURAN	35 J	700 U					
FLUORANTHENE	160 J	220 J					
FLUORENE	47 J	700 U					

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TABLE 7-11
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	T9-A	T9-B					
LOCATION:	T9-A	T9-B					
SAMPLE DATE:	11/30/94	11/30/94					
INVESTIGATION:	FFS	FFS					
SAMPLE TYPE:	GRAB	GRAB					
SEMIVOLATILES (UG/KG)							
INDENO(1,2,3-CD)PYRENE	140 J	170 J					
NAPHTHALENE	77 J	700 U					
PENTACHLOROPHENOL	1400 U	1700 U					
PHENANTHRENE	160 J	140 J					
PYRENE	430 J	690 J					
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	630 J	7 UJ					
4,4'-DDE	49 J	7 UJ					
4,4'-DDT	57 UR	7 UJ					
ALDRIN	29 UJ	3.6 UJ					
ALPHA-CHLORDANE	6 J	3.6 U					
AROCLOR-1260	57 U	70 U					
BETA-BHC	29 UJ	3.6 UJ					
DELTA-BHC	2.9 U	3.6 U					
DIELDRIN	5.7 U	7 U					
ENDOSULFAN II	5.7 U	7 U					
ENDOSULFAN SULFATE	5.7 U	7 U					
ENDOSULFAN-I	2.9 U	3.6 U					
ENDRIN	5.7 U	7 U					
ENDRIN ALDEHYDE	5.7 U	7 U					
ENDRIN KETONE	5.7 U	7 U					
GAMMA-BHC (LINDANE)	2.9 UJ	3.6 UJ					
GAMMA-CHLORDANE	2.9 U	3.6 U					
HEPTACHLOR	2.9 U	3.6 U					
HEPTACHLOR EPOXIDE	2.9 U	3.6 U					
METHOXYCHLOR	29 UJ	36 UJ					
INORGANICS (MG/KG)							
ALUMINUM	18100	15100					
ANTIMONY	0.72 U	0.85 U					
ARSENIC	7.2	10.8					
BARIUM	86.8	47.7					
BERYLLIUM	0.81	0.73					

TABLE 7-11

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	T9-A	T9-B					
LOCATION:	T9-A	T9-B					
SAMPLE DATE:	11/30/94	11/30/94					
INVESTIGATION:	FFS	FFS					
SAMPLE TYPE:	GRAB	GRAB					
INORGANICS (MG/KG)							
BORON	14.7	39.6					
CADMIUM	0.57	0.43 J					
CALCIUM	2640	4110					
CHROMIUM	48.5	59.9					
COBALT	8.1	9.0					
COPPER	48.1	37.2					
CYANIDE	0.9 UJ	1.1 UJ					
IRON	25500	30300					
LEAD	40.6	39.3					
MAGNESIUM	6100	8450					
MANGANESE	313	355					
MERCURY	0.27 U	0.21 UJ					
NICKEL	20.7	23.8					
POTASSIUM	3300 J	4410 J					
SELENIUM	1.8 J	1.9 J					
SILVER	0.18 J	0.21 U					
SODIUM	1930	4980					
VANADIUM	49.0	43.8					
ZINC	132 J	82.8 J					
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON (MG/KG)	34700	61600					

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WMW2(0-2)	2WMW3(10-12)	2WMW3(16-18)	2WMW5(0-2)	2WTB11(0-2)	2WMW5(10-12)	2WMW5(13)
DEPTH (feet):	0 - 2	10 - 12	16 - 18	0 - 2	0 - 2	10 - 12	13 - 13.2
LOCATION:	2WMW2S	2WMW3S	2WMW3S	2WMW5S	2WMW5S	2WMW5S	2WMW5S
SAMPLE DATE:	08/23/90	08/21/90	08/21/90	09/04/90	09/04/90	09/04/90	09/04/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

1,1-DICHLOROETHENE	5 U	5 U	7 U	8 UJ	8 U	11 U	7 U
2-BUTANONE	11 U	11 U	14 U	17 UJ	17 U	71 J	40
ACETONE	11 U	11 U	70	17 UJ	17 U	300	230
BENZENE	5 U	5 U	7 U	8 UJ	8 U	11 U	3 J
CARBON DISULFIDE	5 U	5 U	37	8 UJ	8 U	32	4 J
METHYLENE CHLORIDE	5 U	5 U	7 U	8 UJ	8 U	11 U	7 U
TETRACHLOROETHENE	5 U	5 U	7 U	3 UJ	8 U	11 U	7 U
TRICHLOROETHENE	5 U	5 U	7 U	8 UJ	8 U	11 U	7 U

SEMIVOLATILES (UG/KG)

ACENAPHTHYLENE	350 U	360 U	470 U	550 U	59 J	720 U	480 U
ANTHRACENE	350 U	360 U	470 U	550 U	560 U	720 U	480 U
BENZO(A)ANTHRACENE	83 J	360 U	470 U	160 J	140 J	720 U	480 U
BENZO(A)PYRENE	81 J	360 U	470 U	550 U	560 U	720 U	480 U
BENZO(B)FLUORANTHENE	74 J	360 U	470 U	180 J	260 J	720 U	480 U
BENZO(K)FLUORANTHENE	71 J	360 U	470 U	120 J	180 J	720 U	480 U
BENZOIC ACID	1700 U	1800 U	2300 U	2700 U	2700 U	3500 U	2300 U
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	360 U	470 U	790	590	290 J	1500
CHRYSENE	110 J	360 U	470 U	230 J	330 J	720 U	480 U
FLUORANTHENE	160 J	360 U	3 J	180 J	240 J	120 J	480 U
INDENO(1,2,3-CD)PYRENE	350 U	360 U	470 U	550 U	560 U	720 U	480 U
PHENANTHRENE	120 J	360 U	470 U	130 J	160 J	720 U	480 U
PYRENE	150 J	360 U	8 J	320 J	330 J	120 J	480 U

PESTICIDES/PCBs (UG/KG)

4,4'-DDD	17 U	18 U	23 U	27 U	27 U	35 U	23 U
AROCLOR-1260	170 U	180 U	230 U	270 U	270 U	350 U	230 U

INORGANICS (MG/KG)

ALUMINUM	13000	8300	16300	11200 J	11500 J	14300 J	10500 J
ARSENIC	2.5	2.5	7.8	7.0 J	7.6 J	7.6 J	2.3 J
BARIUM	53.3	58.4	49.3	45.7	41.3	48.4	31.4
BERYLLIUM	0.55	0.4	0.92	1.2 J	1.3 J	1.9 J	1.2 J
CADMIUM	6.9	4.1	8.5	4.7	4.9	6.6	2.7
CALCIUM	1170 J	1630 J	3500 J	1230 J	1310 J	3680 J	1190 J

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WMW2(0-2)	2WMW3(10-12)	2WMW3(16-18)	2WMW5(0-2)	2WTB11(0-2)	2WMW5(10-12)	2WMW5(13)
DEPTH (feet):	0 - 2	10 - 12	16 - 18	0 - 2	0 - 2	10 - 12	13 - 13.2
LOCATION:	2WMW2S	2WMW3S	2WMW3S	2WMW5S	2WMW5S	2WMW5S	2WMW5S
SAMPLE DATE:	08/23/90	08/21/90	08/21/90	09/04/90	09/04/90	09/04/90	09/04/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

CHROMIUM	20.5 J	15.9 J	37.9 J	57.1	65.2	56.5	22.7
COBALT	8.5	7.0	9.7	7.3	12.3	12.2	10.3
COPPER	26.1 J	20.4 J	17.8 J	38.5	35.2	36.0	11.6
IRON	14200	11400	26800	21500	23100	26100	10800
LEAD	16.3 J	4.8 J	10.3 J	38.5	26.8	34.4 J	7.0
MAGNESIUM	4170	3560	7430	5520	5590	7670	2910 J
MANGANESE	195 J	190 J	311	160 J	357 J	365	202
MERCURY	0.11 U	0.1 U	0.16 U	0.22	0.25	0.19	0.14 U
NICKEL	25.3 J	15.8 J	31.3 J	14.7	15.9	26.9	8.8
POTASSIUM	2130 J	2670 J	4280 J	3180	2420	3670	1400
SELENIUM	0.44 U	0.44 U	0.64 U	0.7	0.77	0.76 U	0.54 U
SILVER	1.8 U	1.6 U	2.6 U	2.5 U	2.5 U	2.9 U	2.1 U
SODIUM	118 J	252 J	5260	957 J	930 J	3090 J	1340 J
VANADIUM	33.2	21.0	43.3	48.9 J	51.8 J	59.7 J	30.5 J
ZINC	125 J	37.7 J	99.8 J	54.6 J	61.3 J	93.9 J	38.5 J

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WMW5(4-6)	2WMW6(2-4)	2WTB1(10-12)	2WTB1(15-17)	2WTB1(20-22)	2WTB1(8-10)	2WTB2(0-2)
DEPTH (feet):	4 - 6	2 - 4	10 - 12	15 - 17	20 - 22	8 - 10	0 - 2
LOCATION:	2WMW5S	2WMW6S	2WTB1	2WTB1	2WTB1	2WTB1	2WTB2
SAMPLE DATE:	09/04/90	10/03/90	09/05/90	09/05/90	09/05/90	09/05/90	09/06/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
1,1-DICHLOROETHENE	9 U	8 U	10 U	9 U	2 J	10 U	10 U
2-BUTANONE	17 U	16 U	21 U	18 U	17 UJ	20 U	20 U
ACETONE	130	74	93	27	66 J	78	20 U
BENZENE	9 U	8 U	10 U	9 U	9 UJ	10 U	10 U
CARBON DISULFIDE	23	15	17 J	37 J	25 J	13 J	10 U
METHYLENE CHLORIDE	2 J	8 U	10 U	41 U	3 J	10 U	10 U
TETRACHLOROETHENE	9 U	3 J	10 U	9 U	9 UJ	10 U	10 U
TRICHLOROETHENE	9 U	8 U	10 U	9 U	12 J	10 U	10 U
SEMIVOLATILES (UG/KG)							
ACENAPHTHYLENE	570 U	2600 U	690 U	590 U	570 U	660 U	2600 U
ANTHRACENE	570 U	2600 U	690 U	590 U	570 U	660 U	2600 U
BENZO(A)ANTHRACENE	120 J	370 J	690 U	590 U	130 J	660 U	400 J
BENZO(A)PYRENE	570 U	2600 U	690 U	590 U	570 U	660 U	2600 U
BENZO(B)FLUORANTHENE	110 J	2600 U	690 U	590 U	110 J	660 U	2600 U
BENZO(K)FLUORANTHENE	570 U	2600 U	690 U	590 U	130 J	660 U	2600 U
BENZOIC ACID	2800 U	12000 U	3300 U	2900 U	2800 U	3200 U	13000 U
BIS(2-ETHYLHEXYL)PHTHALATE	570 U	2600 U	130 J	180 J	570 U	120 J	2600 U
CHRYSENE	60 J	330 J	690 U	590 U	140 J	660 U	2600 U
FLUORANTHENE	90 J	460 J	690 U	81 J	170 J	660 U	460 J
INDENO(1,2,3-CD)PYRENE	570 U	2600 U	690 U	590 U	570 U	660 U	2600 U
PHENANTHRENE	570 U	2600 U	690 U	590 U	85 J	660 U	2600 U
PYRENE	83 J	360 J	69 J	120 J	270 J	660 U	380 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	28 U	44 UJ	33 UJ	29 UJ	28 UJ	32 UJ	31 U
AROCLOR-1260	280 U	440 UJ	330 UJ	290 UJ	280 UJ	320 UJ	370 J
INORGANICS (MG/KG)							
ALUMINUM	11700 J	14100	12600 J	13100 J	10600 J	14500 J	14100 J
ARSENIC	6.4 J	7.7 J	9.1	7.9	6.1	6.8	6.7 J
BARIUM	37.9	45.6 J	40.8	40.0	35.9	43.7	52.1
BERYLLIUM	1.6 J	0.57 J	0.5 J	0.44 J	0.36 J	0.52 J	1.8 J
CADMIUM	5.4	4.5 J	0.38 U	0.35 U	0.34 U	0.37 U	6.9
CALCIUM	4180 J	1450 J	12900	6540	5000	5740	3300 J

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WMW5(4-6)	2WMW6(2-4)	2WTB1(10-12)	2WTB1(15-17)	2WTB1(20-22)	2WTB1(8-10)	2WTB2(0-2)
DEPTH (feet):	4 - 6	2 - 4	10 - 12	15 - 17	20 - 22	8 - 10	0 - 2
LOCATION:	2WMW5S	2WMW6S	2WTB1	2WTB1	2WTB1	2WTB1	2WTB2
SAMPLE DATE:	09/04/90	10/03/90	09/05/90	09/05/90	09/05/90	09/05/90	09/06/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

CHROMIUM	34.6	51.0 J	39.0	38.6	38.9	41.8	41.2
COBALT	9.4	7.0 J	10.6	10.0	8.6	10.9	11.1
COPPER	15.7	31.1 J	19.5 J	17.0 J	22.0 J	18.3 J	20.2
IRON	21600	28000 J	26100	24500	21400	26800	27200
LEAD	12.0	298	13.6 J	14.7 J	18.3 J	13.2 J	11.2 J
MAGNESIUM	7370	5070	7380	7470	6600	7740	7230
MANGANESE	287	176 J	305 J	286 J	241 J	312 J	306
MERCURY	0.15 U	0.41 J	0.22 U	0.18 U	0.16 U		0.18 U
NICKEL	21.0	16.1 J	19.8	19.9	10.3	22.1	25.9
POTASSIUM	3360	3010	3830	3860	3340	4050	3530
SELENIUM	0.65 U	0.7 J	0.75 U	0.78	0.83	0.86	0.71 U
SILVER	2.6 U	2.4 UR	3.1 U	2.8 U	2.8 U	2.8 U	2.8 U
SODIUM	4470 J	169 J	4410	7380	7530	4750	2040 J
VANADIUM	50.1 J	42.4	37.6 J	36.7 J	33.3 J	39.9 J	57.9 J
ZINC	60.6 J	59.7 J	70.3 J	61.6 J	62.1 J	71.0 J	75.5 J

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	090690-2WTB9(4-6)	2WTB2(10-12)	2WTB2(15-17)	2WTB2(20-22)	2WTB2(4-6)	2WTB3(10-12)	2WTB3(15-17)
DEPTH (feet):	0 - 2	10 - 12	15 - 17	20 - 22	4 - 6	10 - 12	15 - 17
LOCATION:	2WTB2	2WTB2	2WTB2	2WTB2	2WTB2	2WTB3	2WTB3
SAMPLE DATE:	09/06/90	09/06/90	09/06/90	09/06/90	09/06/90	08/31/90	08/31/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
1,1-DICHLOROETHENE	9 U	9 U	9 U	10 U	9 U	9 U	9 U
2-BUTANONE	18 U	16 J	10 J	20 J	19 U	17 J	12 J
ACETONE	18 U	71	17 U	98	89	350	47 U
BENZENE	9 U	9 U	9 U	10 U	9 U	9 U	9 U
CARBON DISULFIDE	9 U	32	4 J	33	42	15	16
METHYLENE CHLORIDE	9 U	9 U	9 U	10 U	9 U	9 U	9 U
TETRACHLOROETHENE	9 U	9 U	9 U	10 U	9 U	9 U	9 U
TRICHLOROETHENE	9 U	9 U	9 U	10 U	9 U	9 U	9 U
SEMIVOLATILES (UG/KG)							
ACENAPHTHYLENE	590 U	660 U	570 U	560 U	590 U	570 U	580 U
ANTHRACENE	590 U	660 U	570 U	560 U	590 U	570 U	580 U
BENZO(A)ANTHRACENE	590 U	660 U	83 J	64 J	590 U	170 J	580 U
BENZO(A)PYRENE	590 U	660 U	570 U	560 U	590 U	180 J	580 U
BENZO(B)FLUORANTHENE	590 U	660 U	90 J	560 U	590 U	190 J	580 U
BENZO(K)FLUORANTHENE	590 U	660 U	89 J	80 J	590 U	130 J	580 U
BENZOIC ACID	2900 U	3200 U	2800 U	2700 U	2900 U	2800 U	2800 U
BIS(2-ETHYLHEXYL)PHTHALATE	590 U	130 J	130 J	1700	590 U	280 J	210 J
CHRYSENE	590 U	660 U	81 J	62 J	590 U	220 J	580 U
FLUORANTHENE	590 U	660 U	110 J	72 J	590 U	170 J	68 J
INDENO(1,2,3-CD)PYRENE	590 U	660 U	570 U	560 U	590 U	570 U	580 U
PHENANTHRENE	590 U	660 U	69 J	560 U	590 U	120 J	580 U
PYRENE	590 U	660 U	130 J	84 J	70 J	370 J	99 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	29 U	29 U	28 U	27 U	30 U	28 U	28 U
AROCLOR-1260	290 UJ	290 U	280 U	270 U	300 U	280 U	280 U
INORGANICS (MG/KG)							
ALUMINUM	14500 J	14100 J	11800 J	11800 J	13800 J	20600 J	16800 J
ARSENIC	8.1 J	1.1 U	6.8 J	6.3 J	7.1 J	3.9 J	6.3 J
BARIUM	47.7	44.1	40.4	37.7	43.3	44.7	50.9
BERYLLIUM	1.7 J	1.9 J	1.6 J	1.6 J	1.9 J	1.5 J	1.7 J
CADMIUM	7.2	6.4	5.5	5.5	6.5	6.1 J	6.6 J
CALCIUM	3690 J	5090	5660	4900	4620	3620	5050

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	090690-2WTB9(4-6)	2WTB2(10-12)	2WTB2(15-17)	2WTB2(20-22)	2WTB2(4-6)	2WTB3(10-12)	2WTB3(15-17)
DEPTH (feet):	0 - 2	10 - 12	15 - 17	20 - 22	4 - 6	10 - 12	15 - 17
LOCATION:	2WTB2	2WTB2	2WTB2	2WTB2	2WTB2	2WTB3	2WTB3
SAMPLE DATE:	09/06/90	09/06/90	09/06/90	09/06/90	09/06/90	08/31/90	08/31/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
INORGANICS (MG/KG)							
CHROMIUM	39.9	39.3	39.5	36.7	40.9	59.5	43.0
COBALT	10.8	10.8	9.8	8.7	10.4	9.4	10.5
COPPER	17.1	15.8	20.9	17.7	19.1	36.8	21.1
IRON	27600	25800	22300	21700	24500	21000	24400
LEAD	11.2	10.2	14.3 J	12.9	11.8 J	33.7	15.8 J
MAGNESIUM	7630	8970	7790	7850	8660	7620	8580
MANGANESE	376	343	282	283	327	262	333
MERCURY	0.17 U	0.18 U	0.16 U	0.15 U	0.15 U	0.23 J	0.17 U
NICKEL	26.8	25.2	21.6	21.5	26.0	24.3	26.3
POTASSIUM	3800	4150	3520	3490	4010	3690 J	4490
SELENIUM	0.7 U	0.75	0.66 U	0.66 U	0.81	0.7 U	0.63 U
SILVER	3.5	2.9 U	2.7 U	2.6 U	4.0	31.8	3.1
SODIUM	1980 J	9970 J	8540 J	8520 J	6700 J	9690	9390
VANADIUM	56.7 J	58.7 J	50.3 J	51.1 J	54.7 J	49.8 J	57.5 J
ZINC	66.4 J	69.8 J	66.7 J	65.3 J	70.7 J	91.8 J	67.8 J

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WTB3(20-22)	2WTB3(4-6)	083190-2WTB9(4-6)	2WTB4(0-2)	2WTB6(0-2)	2WTB6(15-17)	2WTB6(20-22)
DEPTH (feet):	20 - 22	4 - 6	4 - 6	0 - 2	0 - 2	15 - 17	20 - 22
LOCATION:	2WTB3	2WTB3	2WTB3	2WTB4	2WTB6	2WTB6	2WTB6
SAMPLE DATE:	08/31/90	08/31/90	08/31/90	09/06/90	09/06/90	09/06/90	09/06/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
1,1-DICHLOROETHENE	8 U	9 U	9 U	8 U	11 U	10 U	9 UJ
2-BUTANONE	17 U	20	18 U	16 U	87	13 J	18 UJ
ACETONE	18 U	100 U	34 U	16 U	540	50	63 J
BENZENE	8 U	9 U	9 U	8 U	11 U	10 U	9 UJ
CARBON DISULFIDE	9	23	15	8 U	6 J	10 J	27 J
METHYLENE CHLORIDE	2 J	9 U	9 U	8 U	11 U	10 U	9 UJ
TETRACHLOROETHENE	8 U	9 U	9 U	8 U	11 U	10 U	9 UJ
TRICHLOROETHENE	8 U	9 U	9 U	4 J	11 U	10 U	9 UJ
SEMIVOLATILES (UG/KG)							
ACENAPHTHYLENE	550 U	620 U	600 U	77 J	720 U	560 U	570 U
ANTHRACENE	550 U	620 U	79 J	52 J	720 U	560 U	570 U
BENZO(A)ANTHRACENE	550 U	120 J	190 J	220 J	200 J	120 J	67 J
BENZO(A)PYRENE	550 U	620 U	600 U	230 J	190 J	150 J	570 U
BENZO(B)FLUORANTHENE	550 U	620 U	190 J	220 J	210 J	93 J	570 U
BENZO(K)FLUORANTHENE	550 U	620 U	160 J	310 J	250 J	170 J	96 J
BENZOIC ACID	2700 U	3000 U	2900 U	160 J	130 J	2700 U	2800 U
BIS(2-ETHYLHEXYL)PHTHALATE	550 U	510 J	880	280 J	350 J	560 U	73 J
CHRYSENE	550 U	150 J	240 J	320 J	250 J	110 J	81 J
FLUORANTHENE	120 J	130 J	210 J	310 J	300 J	150 J	87 J
INDENO(1,2,3-CD)PYRENE	550 U	620 U	600 U	530 U	720 U	560 U	570 U
PHENANTHRENE	67 J	85 J	110 J	270 J	160 J	76 J	570 U
PYRENE	190 J	250 J	440 J	460 J	270 J	180 J	84 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	28 U	30 U	28 U	26 UJ	69 J	27 U	29 U
AROCLOR-1260	280 U	300 U	280 U	260 UJ	350 UJ	270 U	290 U
INORGANICS (MG/KG)							
ALUMINUM	12500 J	16600 J	14800 J	15300 J	16800 J	12000 J	10500 J
ARSENIC	11.5 J	10.3 J	11.7 J	8.7	8.4	7.1 J	6.7 J
BARIUM	39.3	47.9	46.5	61.3	60.7	41.5	37.3
BERYLLIUM	1.5 J	1.8 J	1.7 J	0.3 U	0.73 J	1.7 J	1.6 J
CADMIUM	5.4 J	6.5 J	11.5 J	0.29 U	1.9 J	5.9	5.0
CALCIUM	6790	4550	4020	1250	1660	4820	6380

TABLE 7-12
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB3(20-22)	2WTB3(4-6)	083190-2WTB9(4-6)	2WTB4(0-2)	2WTB6(0-2)	2WTB6(15-17)	2WTB6(20-22)
DEPTH (feet):	20 - 22	4 - 6	4 - 6	0 - 2	0 - 2	15 - 17	20 - 22
LOCATION:	2WTB3	2WTB3	2WTB3	2WTB4	2WTB6	2WTB6	2WTB6
SAMPLE DATE:	08/31/90	08/31/90	08/31/90	09/06/90	09/06/90	09/06/90	09/06/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

INORGANICS (MG/KG)

CHROMIUM	40.1	60.6	70.0	89.0	101	44.9	37.8
COBALT	8.8	10.0	9.5	8.5	9.4	8.8	9.0
COPPER	29.9	39.9	47.2	47.6 J	64.1 J	25.9	21.2
IRON	20500	24600	22600	30800	27100	21600	20800
LEAD	17.2 J	15.3 J	46.0 J	128 J	44.0 J	22.5	16.6
MAGNESIUM	7470	8520	7820	6130	6540	7860	7550
MANGANESE	264	316	281	188 J	202 J	276	271
MERCURY	0.15 U	1.1	0.24 J	0.69 J	0.23 U	0.17 U	0.16 U
NICKEL	32.1	28.6	24.2	16.7	20.2	22.6	20.7
POTASSIUM	3320 J	3850 J	3540 J	4320	3680	3590	3320
SELENIUM	0.67 U	0.74 U	0.72 U	1.2	1.5	0.79	0.74
SILVER	2.7 U	3.0 U	2.9 U	2.4 U	3.2 U	3.7	2.6 U
SODIUM	9210	8920	9590	232 J	1570 J	9010 J	8810 J
VANADIUM	46.3 J	56.8 J	53.4 J	50.5 J	52.0 J	51.7 J	49.4 J
ZINC	66.8 J	95.9 J	109 J	60.8 J	74.9 J	69.6 J	61.5 J

TABLE 7-12
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB6(4-6)	2WTB7(0-2)	2WTB7(25-27)	2WTB7(10-12)	2WTB7(4-6)	2WTB8(1-3)	2WTB8(10-12)
DEPTH (feet):	4 - 6	0 - 2	0 - 2	10 - 12	4 - 6	1 - 3	10 - 12
LOCATION:	2WTB6	2WTB7	2WTB7	2WTB7	2WTB7	2WTB8	2WTB8
SAMPLE DATE:	09/06/90	09/05/90	09/05/90	09/05/90	09/05/90	08/30/90	08/30/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
1,1-DICHLOROETHENE	9 U	9 U	8 U	9 U	5 U	10 U	10 U
2-BUTANONE	19 U	19 U	5 J	18 U	70	310	14 J
ACETONE	310	19 U	37	18 U	320	850	56
BENZENE	9 U	9 U	8 U	9 U	5 U	10 U	10 U
CARBON DISULFIDE	6 J	9 U	8 U	9 U	2 J	8 J	14
METHYLENE CHLORIDE	9 U	9 U	8 U	9 U	5 U	4 J	10 U
TETRACHLOROETHENE	9 U	9 U	8 U	9 U	5 U	7 J	10 U
TRICHLOROETHENE	9 U	9 U	8 U	9 U	5 U	10 U	10 U
SEMIVOLATILES (UG/KG)							
ACENAPHTHYLENE	610 U	620 U	530 U	600 U	580 U	120 J	650 U
ANTHRACENE	610 U	620 U	530 U	600 U	580 U	79 J	650 U
BENZO(A)ANTHRACENE	610 U	620 U	530 U	600 U	580 U	370 J	650 U
BENZO(A)PYRENE	610 U	620 U	530 U	600 U	580 U	390 J	650 U
BENZO(B)FLUORANTHENE	610 U	620 U	530 U	600 U	140 J	550 J	650 U
BENZO(K)FLUORANTHENE	610 U	620 U	530 U	600 U	67 J	390 J	650 U
BENZOIC ACID	3000 U	3000 U	220 J	2900 U	2800 U	3300 U	3100 U
BIS(2-ETHYLHEXYL)PHTHALATE	100 J	620 U	220 J	600 U	580 U	1300	500 J
CHRYSENE	610 U	620 U	530 U	600 U	110 J	600 J	650 U
FLUORANTHENE	610 U	72 J	53 J	600 U	100 J	600 J	120 J
INDENO(1,2,3-CD)PYRENE	610 U	620 U	530 U	600 U	580 U	270 J	650 U
PHENANTHRENE	610 U	620 U	530 U	600 U	62 J	340 J	650 U
PYRENE	60 J	98 J	530 U	600 U	140 J	570 J	160 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	30 UJ	30 U	26 U	29 U	28 U	33 U	31 U
AROCLOR-1260	300 UJ	300 U	260 U	290 U	280 U	330 U	310 U
INORGANICS (MG/KG)							
ALUMINUM	12500 J	13900 J	15900 J	11900 J	14700 J	17900 J	26000 J
ARSENIC	8.5	7.2 J	6.9 J	7.8 J	5.9 J	6.8 J	2.2 J
BARIUM	39.2	49.3	45.1	38.7	43.0	93.8	78.8
BERYLLIUM	0.44 J	1.5 J	1.8 J	1.7 J	1.6 J	1.8 J	1.9 J
CADMIUM	0.36 U	4.5	6.7	5.3	5.3	6.7 J	3.3 J
CALCIUM	4980	1590 J	1530 J	6930	4380	2360	2130

TABLE 7-12

**SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WTB6(4-6)	2WTB7(0-2)	2WTB7(25-27)	2WTB7(10-12)	2WTB7(4-6)	2WTB8(1-3)	2WTB8(10-12)
DEPTH (feet):	4 - 6	0 - 2	0 - 2	10 - 12	4 - 6	1 - 3	10 - 12
LOCATION:	2WTB6	2WTB7	2WTB7	2WTB7	2WTB7	2WTB8	2WTB8
SAMPLE DATE:	09/06/90	09/05/90	09/05/90	09/05/90	09/05/90	08/30/90	08/30/90
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
INORGANICS (MG/KG)							
CHROMIUM	37.7	72.7	41.0	35.3	43.7	102	39.7
COBALT	10.5	7.6	12.7	9.0	9.0	9.2	6.7 U
COPPER	16.7 J	35.4	39.1	15.4	24.0	55.0	10.2
IRON	24600	20200	23100	23600	21900	27900	8200
LEAD	15.7 J	49.5 J	12.7 J	13.3	21.3	83.7	16.0 J
MAGNESIUM	7210	6580	6950	7750	7690	7840	3400 J
MANGANESE	288 J	189	265	310	267	233	142
MERCURY	0.19 U	0.38	0.21	0.18 U	0.17 U	0.67 J	0.17 U
NICKEL	20.0	16.8	26.2	21.2	21.0	26.9	13.7
POTASSIUM	3730	2680	3520	3470	3390	4040 J	2120 J
SELENIUM	0.75	0.79 U	0.78 U	0.71 U	0.69 U	0.93 J	0.72 J
SILVER	3.0 U	3.0 U	3.0 U	2.9 U	2.7 U	4.5	2.7 U
SODIUM	6240	1310 J	1430 J	4920 J	5650 J	3150	2380 J
VANADIUM	36.0 J	56.9 J	60.6 J	54.0 J	53.0 J	75.0 J	41.8 J
ZINC	64.8 J	59.5 J	79.8 J	61.7 J	66.2 J	62.9 J	44.8 J

TABLE 7-12
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB8(6-8)						
DEPTH (feet):	6 - 8	-	-	-	-	-	-
LOCATION:	2WTB8						
SAMPLE DATE:	08/30/90	//	//	//	//	//	//
INVESTIGATION:	PH1						
SAMPLE TYPE:	GRAB						
STATUS:							
VOLATILES (UG/KG)							
1,1-DICHLOROETHENE	9 U						
2-BUTANONE	19 U						
ACETONE	50						
BENZENE	9 U						
CARBON DISULFIDE	15						
METHYLENE CHLORIDE	9 U						
TETRACHLOROETHENE	9 U						
TRICHLOROETHENE	9 U						
SEMIVOLATILES (UG/KG)							
ACENAPHTHYLENE	620 U						
ANTHRACENE	620 U						
BENZO(A)ANTHRACENE	620 U						
BENZO(A)PYRENE	620 U						
BENZO(B)FLUORANTHENE	620 U						
BENZO(K)FLUORANTHENE	620 U						
BENZOIC ACID	3000 U						
BIS(2-ETHYLHEXYL)PHTHALATE	130 J						
CHRYSENE	620 U						
FLUORANTHENE	110 J						
INDENO(1,2,3-CD)PYRENE	620 U						
PHENANTHRENE	620 U						
PYRENE	120 J						
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	30 U						
AROCLOR-1260	300 U						
INORGANICS (MG/KG)							
ALUMINUM	13300 J						
ARSENIC	5.2 J						
BARIUM	42.4						
BERYLLIUM	1.7 J						
CADMIUM	5.7 J						
CALCIUM	6290						

TABLE 7-12
 SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
 AREA A WETLAND; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB8(6.8)						
DEPTH (feet):	6 - 8						
LOCATION:	2WTB8						
SAMPLE DATE:	08/30/90	//	//	//	//	//	//
INVESTIGATION:	PH1						
SAMPLE TYPE:	GRAB						
STATUS:							
INORGANICS (MG/KG)							
CHROMIUM	43.7						
COBALT	10.0						
COPPER	24.5						
IRON	23100						
LEAD	22.4						
MAGNESIUM	7660						
MANGANESE	300						
MERCURY	0.18 U						
NICKEL	23.5						
POTASSIUM	3410 J						
SELENIUM	0.75 U						
SILVER	6.6						
SODIUM	5250						
VANADIUM	53.9 J						
ZINC	71.5 J						

TABLE 7-13
SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WMW2(0-2)	2WMW3(10-12)	2WMW3(16-18)	2WMW5(0-2)	2WTB11(0-2)	2WMW5(10-12)	2WMW5(13)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	08/23/90	08/21/90	08/21/90	09/04/90	09/04/90	09/04/90	09/04/90
LOCATION:	2WMW2S	2WMW3S	2WMW3S	2WMW5S	2WMW5S	2WMW5S	2WMW5S
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0030 U	0.0020 U	0.0020 U
ENDRIN (0.02/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0003 U	0.0002 U	0.0002 U
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0003 U	0.0002 U	0.0002 U
HEPTACHLOR (0.008/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0003 U	0.0002 U	0.0002 U
METHOXYCHLOR (10.0/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0030 U	0.0020 U	0.0020 U
TOXAPHENE (0.5/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0030 U	0.0020 U	0.0020 U
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.220	0.210	0.230	0.0020 U	0.0020 U	0.0024	0.0020 U
BARIUM (100.0/10.0)	0.360	0.330	0.0780	0.0320 U	0.0380	0.120	0.0930
CADMIUM (1.0/0.05)	0.0063	0.0050 U	0.0050 U	0.0140 U	0.0140 U	0.0140 U	0.0160
CHROMIUM (5.0/0.5)	0.0500 U	0.0500 U	0.0500 U	0.0400 J	0.0490 J	0.0380 J	0.0630 J
LEAD (5.0/0.15)	0.100 U	0.100 U	0.100 U	0.0020 U	0.0027 J	0.0020 U	0.0056 J
MERCURY (0.2/0.02)	0.0002 U	0.0003 U	0.0003 U	0.0004 U	0.0004 U	0.0004 U	0.0004 U
SELENIUM (1.0/0.5)	0.160 J	0.100 U	0.160 J	0.0036 J	0.0029 J	0.0043 J	0.0051 J
SILVER (5.0/0.36)	0.0092 J	0.0080 UJ	0.0080 UJ	0.0660 U	0.0660 U	0.0660 U	0.0660 U

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-13**SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WMW5(4-6)	2WMW6(2-4)	2WTB1(10-12)	2WTB1(15-17)	2WTB1(20-22)	2WTB1(8-10)	2WTB2(0-2)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	09/04/90	10/03/90	09/05/90	09/05/90	09/05/90	09/05/90	09/06/90
LOCATION:	2WMW5S	2WMW6S	2WTB1	2WTB1	2WTB1	2WTB1	2WTB2
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
ENDRIN (0.02/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
HEPTACHLOR (0.008/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
METHOXYCHLOR (10.0/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
TOXAPHENE (0.5/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.0087	0.100 U	0.0096	0.0120	0.0081	0.0099	0.0020 U
BARIUM (100.0/10.0)	0.0510	0.0320 U	0.120	0.130	0.0970	0.120	0.670 J
CADMIUM (1.0/0.05)	0.0140 U	0.0050 U	0.0140 U	0.0140 J	0.0140 U	0.0140 U	0.0230
CHROMIUM (5.0/0.5)	0.0380 J	0.0500 U	0.0470 J	0.0490 J	0.0430 J	0.0500 J	0.0750 J
LEAD (5.0/0.15)	0.0024 J	1.50	0.0200 U	0.0200 U	0.0200 U	0.0200 U	0.0020 U
MERCURY (0.2/0.02)	0.0004 U	0.0020 U	0.0002 U	0.0020 U	0.0004 U	0.0020 U	0.0008 U
SELENIUM (1.0/0.5)	0.0045 J	0.100 U	0.0200 U	0.0200 U	0.0200 U	0.0200 U	0.0093 J
SILVER (5.0/0.36)	0.0660 U	0.0080 U	0.0660 U	0.0660 U	0.0660 U	0.0660 U	0.0660 U

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-13
SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	090690-2WTB9(4-6)	2WTB2(10-12)	2WTB2(15-17)	2WTB2(20-22)	2WTB2(4-6)	2WTB3(10-12)	2WTB3(15-17)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	09/06/90	09/06/90	09/06/90	09/06/90	09/06/90	08/31/90	08/31/90
LOCATION:	2WTB2	2WTB2	2WTB2	2WTB2	2WTB2	2WTB3	2WTB3
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
ENDRIN (0.02/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
HEPTACHLOR (0.008/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
METHOXYCHLOR (10.0/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
TOXAPHENE (0.5/NA)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.0200 U	0.0064	0.0100	0.0120	0.0200 U	0.350 J	0.410 J
BARIUM (100.0/10.0)	0.300 J	0.120	0.140	0.130	0.140	0.0320 U	0.0460
CADMIUM (1.0/0.05)	0.0240	0.0140	0.0150	0.0140	0.0150	0.0050 U	0.0050 U
CHROMIUM (5.0/0.5)	0.0530 J	0.0450 J	0.0790 J	0.0660 J	0.0770 J	0.0500 U	0.0500 U
LEAD (5.0/0.15)	0.0020 U	0.0022 J	0.0099 J	0.0200 U	0.0200 U	0.100 UJ	0.100 UJ
MERCURY (0.2/0.02)	0.0020 U	0.0020 U	0.0004 U	0.0020 U	0.0020 U	0.0003	0.0020 U
SELENIUM (1.0/0.5)	0.0200 U	0.0043 J	0.0056 J	0.0200 U	0.0200 U	0.150 J	0.230 J
SILVER (5.0/0.36)	0.0660	0.0660 U	0.0660 U	0.0660 U	0.0680	0.380 J	0.0110 J

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-13
SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB3(20-22)	2WTB3(4-6)	083190-2WTB9(4-6)	2WTB4(0-2)	2WTB6(0-2)	2WTB6(15-17)	2WTB6(20-22)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	08/31/90	08/31/90	08/31/90	09/06/90	09/06/90	09/06/90	09/06/90
LOCATION:	2WTB3	2WTB3	2WTB3	2WTB4	2WTB6	2WTB6	2WTB6
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0022 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
ENDRIN (0.02/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
HEPTACHLOR (0.008/NA)	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
METHOXYCHLOR (10.0/NA)	0.0022 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
TOXAPHENE (0.5/NA)	0.0022 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.260 J	0.220 J	0.260 J	0.0020 U	0.0064	0.0200 U	0.0120
BARIUM (100.0/10.0)	0.0320 U	0.0320 U	0.0410	0.0750	0.120	0.120	0.140
CADMIUM (1.0/0.05)	0.0100	0.0050 U	0.0094	0.0140 U	0.0160 J	0.0160	0.0150
CHROMIUM (5.0/0.5)	0.0500 U	0.0500 U	0.0500 U	0.0470 J	0.0540 J	0.0650 J	0.0750 J
LEAD (5.0/0.15)	0.100 UJ	0.100 UJ	0.100 J	0.0200 U	0.0180 J	0.0200 U	0.0200 U
MERCURY (0.2/0.02)	0.0004 U	0.0006	0.0002 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
SELENIUM (1.0/0.5)	0.170 J	0.100 U	0.120 J	0.0200 U	0.0200 U	0.0200 U	0.0200 U
SILVER (5.0/0.36)	0.0081 J	0.130 J	0.0080 UJ	0.0660 U	0.0700 J	0.0670	0.0660 U

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-13
SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB6(4-6)	2WTB7(0-2)	2WTB7(25-27)	2WTB7(10-12)	2WTB7(4-6)	2WTB8(1-3)	2WTB8(10-12)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH1	PH1	PH1
SAMPLE DATE:	09/06/90	09/05/90	09/05/90	09/05/90	09/05/90	08/30/90	08/30/90
LOCATION:	2WTB6	2WTB7	2WTB7	2WTB7	2WTB7	2WTB8	2WTB8
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0020 U	0.0030 U	0.0020 U	0.0020 U	0.0030 U	0.0020 U	0.0020 U
ENDRIN (0.02/NA)	0.0002 U	0.0003 U	0.0002 U	0.0002 U	0.0003 U	0.0002 U	0.0002 U
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 U	0.0003 U	0.0002 U	0.0002 U	0.0003 U	0.0002 U	0.0002 U
HEPTACHLOR (0.008/NA)	0.0002 U	0.0003 U	0.0002 U	0.0002 U	0.0003 U	0.0002 U	0.0002 U
METHOXYCHLOR (10.0/NA)	0.0020 U	0.0030 U	0.0020 U	0.0020 U	0.0030 U	0.0020 U	0.0020 U
TOXAPHENE (0.5/NA)	0.0020 U	0.0030 U	0.0020 U	0.0020 U	0.0030 U	0.0020 U	0.0020 U
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.0091	0.0200 U	0.0020 U	0.0050	0.0070	0.170 J	0.210 J
BARIUM (100.0/10.0)	0.110	0.130 J	0.0570 J	0.0440	0.0430	0.210	0.0520
CADMIUM (1.0/0.05)	0.0140 J	0.0150	0.0140	0.0160	0.0140	0.0050 U	0.0077
CHROMIUM (5.0/0.5)	0.0530 J	0.0430 J	0.0400 J	0.0400 J	0.0390 J	0.0500 U	0.0500 U
LEAD (5.0/0.15)	0.0200 U	0.0200 U	0.0130 J	0.0190 J	0.0170 J	0.100 UJ	0.100 UJ
MERCURY (0.2/0.02)	0.0020 U	0.0040 U	0.0004 U	0.0002 U	0.0008 U	0.0004 U	0.0002 U
SELENIUM (1.0/0.5)	0.0200 U	0.0042 J	0.0042 J	0.0045 J	0.0061 J	0.100 U	0.130 J
SILVER (5.0/0.36)	0.0660 U	0.0660 U	0.0660 U	0.0660 U	0.0660 U	0.0080 UJ	0.110 J

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-13

SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WTB8(6-8)						
INVESTIGATION:	PH1						
SAMPLE DATE:	08/30/90						
LOCATION:	2WTB8						
SAMPLE TYPE:	GRAB						
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0020 U						
ENDRIN (0.02/NA)	0.0002 U						
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 U						
HEPTACHLOR (0.008/NA)	0.0002 U						
METHOXYCHLOR (10.0/NA)	0.0020 U						
TOXAPHENE (0.5/NA)	0.0020 U						
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.230 J						
BARIUM (100.0/10.0)	0.240						
CADMIUM (1.0/0.05)	0.0050 U						
CHROMIUM (5.0/0.5)	0.0500 U						
LEAD (5.0/0.15)	0.100 UJ						
MERCURY (0.2/0.02)	0.0002 U						
SELENIUM (1.0/0.5)	0.100 U						
SILVER (5.0/0.36)	0.0080 UJ						

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-14

SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SEDIMENT)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	112690-2WSD1(0-0.5)	112690-2WSD10(0-0.5)	112690-2WSD2(0-0.5)	112690-2WSD3(0-0.5)	2WSD39	112690-2WSD4(0-0.5)	112690-2WSD5(0-0.5)
INVESTIGATION:	PH1	PH1	PH1	PH1	PH2-1	PH1	PH1
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/26/90	11/20/93	11/26/90	11/26/90
LOCATION:	2WSD1	2WSD1	2WSD2	2WSD3	2WSD39	2WSD4	2WSD5
SAMPLE TYPE:	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE	GRAB	COMPOSITE	COMPOSITE
STATUS:							

TCLP PESTICIDES (MG/L)*

CHLORDANE (0.03/NA)	0.0020 UJ	0.0020 UJ	0.0020 UJ	0.0020 UJ		0.0020 UJ	0.0020 UJ
ENDRIN (0.02/NA)	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 UJ		0.0002 UJ	0.0002 UJ
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 UJ		0.0002 UJ	0.0002 UJ
HEPTACHLOR (0.008/NA)	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 UJ		0.0002 UJ	0.0002 UJ
METHOXYCHLOR (10.0/NA)	0.0020 UJ	0.0020 UJ	0.0020 UJ	0.0020 UJ		0.0020 UJ	0.0020 UJ
TOXAPHENE (0.5/NA)	0.0020 UJ	0.0020 UJ	0.0020 UJ	0.0020 UJ		0.0020 UJ	0.0020 UJ

TCLP METALS (MG/L)*

ARSENIC (5.0/0.5)	0.300 U	0.300 U	0.300 U	0.300 U	0.0615	0.300 U	0.300 U
BARIUM (100.0/10.0)	0.0590	0.0420	0.0390	0.0250	0.0191 U	0.0150 U	0.0150 U
CADMIUM (1.0/0.05)	0.0023	0.0020 U	0.0036	0.0020 U	0.0080 U	0.0029	0.0020 U
CHROMIUM (5.0/0.5)	0.0070	0.0068	0.0350	0.0073	0.0150	0.0100	0.0073
LEAD (5.0/0.15)	0.100 U	0.100 U	0.100 U	0.100 U	0.0791	0.100 U	0.100 U
MERCURY (0.2/0.02)	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
SELENIUM (1.0/0.5)	0.100 U	0.100 U	0.100 U	0.100 U	0.110	0.100 U	0.100 U
SILVER (5.0/0.36)	0.0070 J	0.0095 J	0.0120 J	0.0070 UR	0.0418 J	0.0070 UR	0.0081 J

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-14
SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SEDIMENT)
AREA A WETLAND; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	112690-2WSD6(0-0.5)	112690-2WSD7(0-0.5)	112690-2WSD8(0-0.5)	112690-2WSD9(0-0.5)			
INVESTIGATION:	PH1	PH1	PH1	PH1			
SAMPLE DATE:	11/26/90	11/26/90	11/26/90	11/26/90			
LOCATION:	2WSD6	2WSD7	2WSD8	2WSD9			
SAMPLE TYPE:	COMPOSITE	COMPOSITE	COMPOSITE	GRAB			
STATUS:							
TCLP PESTICIDES (MG/L)*							
CHLORDANE (0.03/NA)	0.0020 UJ	0.0020 UJ	0.0020 UJ	0.0020 UJ			
ENDRIN (0.02/NA)	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 UJ			
GAMMA-BHC (LINDANE) (0.4/NA)	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 UJ			
HEPTACHLOR (0.008/NA)	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 UJ			
METHOXYCHLOR (10.0/NA)	0.0020 UJ	0.0020 UJ	0.0020 UJ	0.0020 UJ			
TOXAPHENE (0.5/NA)	0.0020 UJ	0.0020 UJ	0.0020 UJ	0.0020 UJ			
TCLP METALS (MG/L)*							
ARSENIC (5.0/0.5)	0.300 U	0.300 U	0.300 U	0.300 U			
BARIUM (100.0/10.0)	0.0270	0.0290	0.0530	0.140			
CADMIUM (1.0/0.05)	0.0020 U	0.0036	0.0020 U	0.0110			
CHROMIUM (5.0/0.5)	0.0130	0.0100	0.0190	0.0100			
LEAD (5.0/0.15)	0.100 U	0.100 U	0.100 U	0.100 U			
MERCURY (0.2/0.02)	0.0020 U	0.0020 U	0.0020 U	0.0020 U			
SELENIUM (1.0/0.5)	0.100 U	0.100 U	0.110	0.100 U			
SILVER (5.0/0.36)	0.0070 UR	0.0160 J	0.0130 J	0.0070 UR			

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 7-15
SUMMARY OF SOIL/SEDIMENT ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	Sediment and Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
1,1-Dichloroethene	0/35	-	ND (3)	1/25	2	2WTB1
2-Butanone	8/35	5-1400	T8-B	11/25	10-71	2WMW5S
Acetone	9/35	37-850	2WTB8	19/25	27-350	2WTB3
Benzene	0/35	-	ND	1/25	3	2WMW5S
Carbon disulfide	9/35	3-18	2WSD3	23/25	2-42	2WTB2
Chlorobenzene	3/36	2-14	T7-B	0/25	-	ND
Methylene chloride	6/35	2-10	2WSD4	3/25	2-3	2WTB1
Tetrachloroethene	5/35	4-16	2WSD4	1/25	3	2WMW6S
Toluene	6/35	3-6	T8-B	0/25	-	ND
Trichloroethene	4/35	3-11	2WSD4	1/25	12	2WTB1
Xylenes, total	1/35	3	T6-B	0/25	-	ND
SEMIVOLATILE ORGANICS (ug/kg)						
1,4-Dichlorobenzene	1/35	42	T6-B	0/25	-	ND
2,4-Dimethylphenol	1/35	210	T8-B	0/25	-	ND
2-Methylnaphthalene	4/35	40-55	T3-A	0/25	-	ND
4-Methylphenol	1/35	43	T9-A	0/25	-	ND
Acenaphthene	9/36	35-380	T7-B	0/25	-	ND
Acenaphthylene	7/35	34-390	T3-A	0/25	-	ND
Anthracene	17/35	34-2400	2WSD9	1/25	79	2WTB3
Benzo(a)anthracene	28/36	25-27000	2WSD9	9/25	64-370	2WMW6S
Benzo(a)pyrene	25/36	30-35000	2WSD9	2/25	150-180	2WTB3
Benzo(b)fluoranthene	26/36	44-55000	2WSD9	7/25	90-190	2WTB3
Benzo(g,h,i)perylene	20/36	27-23000	2WSD9	0/25	-	ND
Benzo(k)fluoranthene	27/36	62-45000	2WSD9	8/25	67-170	2WTB6
Benzoic acid	5/35	130-32000	2WSD9	0/25	-	ND
Bis(2-ethylhexyl)phthalate	6/35	220-3500	T10-B	15/25	73-1700	2WTB2
Butyl benzyl phthalate	5/36	21-390	T7-B	0/25	-	ND
Carbazole	6/19	25-130	T5-A	-	-	NA (4)
Chrysene	28/36	38-42000	2WSD9	10/25	60-330	2WMW6S
Di-n-butyl phthalate	8/35	23-63	T3-B	0/25	-	ND
Dibenzo(a,h)anthracene	6/35	72-310	T2-A	0/25	-	ND
Dibenzofuran	10/36	35-1000	2WSD9	0/25	-	ND
Fluoranthene	33/36	56-80000	2WSD9	17/25	3-460	2WMW6S
Fluorene	12/36	21-1000	2WSD9	0/25	-	ND
Indeno(1,2,3-cd)pyrene	22/36	22-23000	2WSD9	0/25	-	ND
Naphthalene	5/35	56-77	T9-A	0/25	-	ND
Pentachlorophenol	1/35	240	T1-B	0/25	-	ND
Phenanthrene	27/36	22-36000	2WSD9	7/25	62-120	2WTB3
Pyrene	34/36	46-42000	2WSD9	20/25	8-440	2WTB3
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	18/43	4.5-4800	2WSD25	0/25	-	ND
4,4'-DDE	18/46	6.2-720	2WSD25	0/25	-	ND
4,4'-DDT	13/39	4.4-2900	2WSD25	0/25	-	ND
Aldrin	1/44	3.2	T5-A	0/25	-	ND
Alpha-Chlordane	12/46	2.9-29	T6-A	0/25	-	ND
Aroclor-1260	7/40	82-1500	T6-A	0/25	-	ND

TABLE 7-15
SUMMARY OF SOIL/SEDIMENT ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Analyte	Sediment and Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Beta-BHC	1/45	2.7	T5-A	0/25	-	ND
Delta-BHC	1/45	4.2	T5-A	0/25	-	ND
Dieldrin	2/45	8.4-26	T6-A	0/25	-	ND
Endosulfan II	2/43	6.9-31	T2-A	0/25	-	ND
Endosulfan sulfate	2/44	6.9-14	T3-A	0/25	-	ND
Endosulfan I	4/45	2.1-11	T3-A	0/25	-	ND
Endrin	2/45	8.2-16	T5-A	0/25	-	ND
Endrin aldehyde	4/28	5.6-16	T2-A		-	NA
Endrin ketone	1/44	20	T5-A	0/25	-	ND
Gamma-BHC (lindane)	1/45	3.5	T5-A	0/25	-	ND
Gamma-Chlordane	11/45	3.7-23	T6-A	0/25	-	ND
Heptachlor	3/45	2.8-4.5	T5-A	0/25	-	ND
Heptachlor epoxide	4/45	2.2-4.5	T1-B	0/25	-	ND
Methoxychlor	1/44	38	T5-A	0/25	-	ND

INORGANICS (mg/kg)

Aluminum	36/36	2690-27100	T7-B	25/25	8300-26000	2WTB8
Antimony	4/26	0.48-1.2	T7-A	0/24	-	ND
Arsenic	36/36	1-14.1	T8-B	24/25	2.2-11.7	2WTB3
Barium	36/36	11.9-318	T7-B	25/25	31.4-78.8	2WTB8
Beryllium	35/36	0.14-4.1	T7-B	25/25	0.36-1.9	2WTB2
Boron	5/19	14.7-39.6	T9-B	0/0	-	R (5)
Cadmium	32/36	0.12-7.2	2WTB2	20/25	2.7-11.5	2WTB3
Calcium	36/36	868-6800	2WSD8	25/25	1190-12900	2WTB1
Chromium	36/36	7-102	2WTB8	25/25	15.9-70	2WTB3
Cobalt	36/36	3-13.6	T7-B	24/25	7-12.2	2WMW5S
Copper	36/36	14.7-173	T7-B	25/25	10.2-47.2	2WTB3
Cyanide	7/30	0.9-6.1	T7-B	0/25	-	ND
Iron	36/36	5630-198000	T7-B	25/25	8200-28000	2WMW6S
Lead	36/36	11.2-241	2WSD9	25/25	4.8-298	2WMW6S
Magnesium	36/36	1570-9150	T8-B	25/25	2910-8970	2WTB2
Manganese	36/36	55.3-376	2WTB2	25/25	142-365	2WMW5S
Mercury	20/30	0.15-1.2	T6-B	4/24	0.19-1.1	2WTB3
Nickel	36/36	6.6-61.5	T2-A	25/25	8.8-32.1	2WTB3
Potassium	36/36	659-5170	T8-B	25/25	1400-4490	2WTB3
Selenium	20/36	0.77-6.8	T7-B	10/25	0.7-0.86	2WTB1
Silver	11/36	0.18-4.5	2WTB8	5/24	3.1-31.8	2WTB3
Sodium	36/36	114-6650	2WSD8	25/25	169-9970	2WTB2
Vanadium	36/36	8.9-203	T7-B	25/25	21-59.7	2WMW5S
Zinc	36/36	35-702	T7-B	25/25	37.7-109	2WTB3

TCLP METALS (mg/L) (6)

Arsenic (5.0/0.5)	3/7	0.0064-0.22	2WMW2S	21/25	0.0024-0.41	2WTB3
Barium (100.0/10)	7/7	0.038-0.67	2WTB2	22/25	0.041-0.33	2WMW3S
Cadmium (1.0/0.05)	4/7	0.0063-0.024	2WTB2	14/25	0.0077-0.016	2WTB6
Chromium (5.0/0.5)	5/7	0.043-0.075	2WTB2	16/25	0.038-0.079	2WTB2
Lead (5.0/0.15)	3/7	0.0027-0.018	2WTB6	8/25	0.0022-1.5	2WMW6S
Mercury (0.2/0.02)	0/7	-	ND	2/25	0.0003-0.0006	2WTB3
Selenium (1.0/0.5)	4/7	0.0036-0.16	2WMW2S	13/25	0.0043-0.23	2WTB3

TABLE 7-15
SUMMARY OF SOIL/SEDIMENT ANALYTICAL RESULTS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Analyte	Sediment and Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Silver (5.0/0.36)	3/7	0.0092-0.07	2WTB6	7/25	0.0081-0.38	2WTB3
MISCELLANEOUS PARAMETERS (mg/kg)						
Total organic carbon	24/24	8420-91000	2WSD24	-	-	NA

- 1 Includes samples 2WSD1, 2WSD10 (field duplicate of 2WSD1), 2WSD2, 2WSD3, 2WSD4, 2WSD5, 2WSD6, 2WSD7, 2WSD8, 2WSD9, 2WMW2S-0002, 2WMW5-0002, 2WTB11 (field duplicate of 2WMW5-0002), 2WTB2-0002, 090690-2WTB9 (field duplicate of 2WTB2-0002), 2WTB4-0002, 2WTB6-0002, 2WTB7-0002, 2WTB7-2527 (field duplicate of 2WTB7-0002), 2WTB8-0103, 2WSD10 through 2WSD22, and 2WSD27 through 2WSD42. Maximum concentrations are used for evaluation of field duplicates and are counted as one sample.
- 2 Includes samples 2WMW3-1012, 2WMW3-1618, 2WMW5-0406, 2WMW5-1012, 2WMW5-13, 2WMW6-0204, 2WTB1-0810, 2WTB1-1012, 2WTB1-1517, 2WTB1-2022, 2WTB2-0406, 2WTB2-1012, 2WTB2-1517, 2WTB2-2022, 2WTB3-0406, 083190-2WTB9 (field duplicate of 2WTB3-0406), 2WTB3-1012, 2WTB3-1517, 2WTB3-2022, 2WTB6-0406, 2WTB6-1517, 2WTB6-2022, 2WTB7-0406, 2WTB7-1012, 2WTB8-0608, and 2WTB8-1012. Maximum concentrations are used for evaluation of field duplicates and are counted as one sample.
- 3 ND - Not Detected.
- 4 NA - Not Analyzed.
- 5 R - Results rejected during data validation.
- 6 Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Clean-Up Standard Pollutant Mobility Criteria for GB Waters.

TABLE 7-16
CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration ⁽¹⁾			
	Surface Soil/Sediment (mg/kg)	All Soil/Sediment (mg/kg)	Groundwater (mg/L)	Surface Water (mg/L)
Tetrachloroethene	NA ⁽²⁾	NA	NA	0.002 ⁽³⁾
Benzo(a)anthracene	1.3/27	1.1/27	NA	NA
Benzo(b)fluoranthene	2.2/55	1.8/55	NA	NA
Benzo(k)fluoranthene	2.0/45	1.6/45	NA	NA
Benzo(a)pyrene	1.6/35	1.4/35	NA	NA
Bis(2-ethylhexyl)phthalate	NA	NA	0.006/0.016	NA
Dibenz(a,h)anthracene	0.31 ⁽³⁾	0.31 ⁽³⁾	NA	NA
Indeno(1,2,3-cd)pyrene	1.1/23	0.95/23	NA	NA
4,4'-DDD	0.41/4.8	0.33/4.8	NA	NA
4,4'-DDT	0.26/2.9	0.20/2.9	NA	NA
Aroclor-1260	0.19/1.5	0.18/1.5	NA	NA
Antimony	NA	NA	0.0068/0.0086 ⁽⁴⁾	NA
Arsenic	5.7/14.1	6.9	0.0103/0.0826	0.0016/0.0029
Barium	NA	NA	0.174/0.610	NA
Beryllium	1.2	1.3	0.00070/0.0015	NA
Boron	NA	NA	0.443/3.17	0.135/0.369
Cadmium	1.7/7.2	2.4/11.5	0.0026/0.0066	0.0083/0.0666
Chromium	41.3/102	42.2/102	NA	NA
Lead	NA	NA	0.0047/0.0216	NA
Manganese	265	228/376	2.55/8.43	1.87 ⁽⁵⁾
Nickel	NA	NA	0.0151/0.0446	0.0200/0.0847

TABLE 7-16 (Continued)
CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration ⁽¹⁾			
	Surface Soil/Sediment (mg/kg)	All Soil/Sediment (mg/kg)	Groundwater (mg/L)	Surface Water (mg/L)
Thallium	NA	NA	0.0039/0.0089	NA
Vanadium	85.1	56.2/203	0.0065/0.0255	NA

- 1 UCL if single concentration presented, otherwise average for CTE and maximum for RME. For groundwater, maximum is defined as the highest average concentration in a single well, and average is defined as the overall average concentration of all well-specific averages.
- 2 NA - Not applicable. Chemical is not a chemical of concern for this medium.
- 3 Maximum. Average exceeds maximum.
- 4 Dissolved matrix. Chemical not detected in unfiltered samples.
- 5 Maximum. Calculated UCL exceeds maximum.

TABLE 7-17
ESTIMATED RISKS⁽¹⁾
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Hazard Index				Incremental Cancer Risk			
	Older Child Trespasser		Construction Worker		Older Child Trespasser		Construction Worker	
	RME ⁽²⁾	CTE ⁽³⁾	RME	CTE	RME	CTE	RME	CTE
Incidental Ingestion of Soil/Sediment	1.4E-1	5.3E-3	4.3E-1	2.4E-2	4.0E-5	1.1E-7	1.2E-5	1.7E-7
Dermal Contact with Soil/Sediment ⁽⁵⁾	1.8E-1	1.3E-3	1.6E-1	1.8E-3	6.2E-7	5.1E-10	4.6E-8	1.8E-10
Dermal Contact with Groundwater	NA ⁽⁴⁾	NA	2.2E+0	4.7E-1	NA	NA	3.8E-7	1.1E-7
Incidental Ingestion of Surface Water	3.5E-1	3.4E-2	NA	NA	9.7E-7	3.6E-8	NA	NA
Dermal Contact with Surface Water	5.2E-1	6.2E-2	NA	NA	1.5E-7	1.1E-8	NA	NA
Cumulative Risk:	1.2E+0	1.0E-1	2.8E+0	5.0E-1	4.2E-5	1.6E-7	1.2E-5	2.8E-7

1 Chemical-specific risks presented in Appendix F.6.

2 RME - Reasonable Maximum Exposure.

3 CTE - Central Tendency Exposure.

4 NA - Not applicable; exposure route not evaluated for this receptor.

5 Quantitative evaluation performed for cadmium, PCBs, and dioxins (if detected).

TABLE 7-18
ECOLOGICAL CHEMICALS OF CONCERN
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Aquatic Receptors		Benthic Invertebrates		Raccoon		Mallard	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
Benzo(a)pyrene	NA ⁽¹⁾	NA	NA	NA	NA	NA	X ⁽²⁾	NA
Benzo(b)flouranthene	NA	NA	NA	NA	NA	NA	X	NA
Benzo(k)flouranthene	NA	NA	NA	NA	NA	NA	X	NA
Chrysene	NA	NA	NA	NA	NA	NA	X	NA
Flouranthene	NA	NA	X	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	X	NA	X	NA	X	NA
Pyrene	NA	NA	X	NA	NA	NA	NA	NA
4,4'-DDD	NA	NA	X	X	NA	NA	X	X
4,4'-DDE	NA	NA	X	X	NA	NA	X	X
4,4'-DDT	NA	NA	X	X	NA	NA	X	X
Dieldrin	NA	NA	X	X	NA	NA	NA	NA
Endosulfan-I	NA	NA	X	NA	NA	NA	NA	NA
Endosulfan-II	NA	NA	X	NA	NA	NA	NA	NA
Endosulfan-sulfate	NA	NA	X	NA	NA	NA	NA	NA
Gamma-Chlordane	NA	NA	X	X	NA	NA	NA	NA
Heptachlor	NA	NA	X	X	NA	NA	NA	NA
Heptachlor epoxide	NA	NA	X	X	X	X	X	X
Methoxychlor	NA	NA	X	X	NA	NA	NA	NA
Aluminum	X	X	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	X	NA	NA	NA	NA	NA
Barium	X	X	NA	NA	NA	NA	NA	NA
Cadmium	X	X	X	NA	X	X	NA	NA
Chromium	NA	NA	X	NA	X	X	NA	NA
Cobalt	X	X	NA	NA	NA	NA	NA	NA
Copper	X	X	X	X	NA	NA	NA	NA
Cyanide	NA	NA	X	X	NA	NA	NA	NA
Iron	X	X	NA	NA	NA	NA	NA	NA
Lead	X	X	NA	NA	NA	NA	NA	NA

TABLE 7-18 (Continued)
ECOLOGICAL CHEMICALS OF CONCERN
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Aquatic Receptors		Benthic Invertebrates		Raccoon		Mallard	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
Manganese	X	X	NA	NA	NA	NA	NA	NA
Mercury	X	X	X	X	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	X	X	NA	NA
Zinc	X	X	NA	NA	X	X	NA	NA

TABLE 7-18 (Continued)
ECOLOGICAL CHEMICALS OF CONCERN
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Terrestrial Vegetation		Soil Invertebrates		Short-Tailed Shrew		Red-Tailed Hawk	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
4,4'-DDD	NA	NA	NA	NA	NA	NA	X	X
Aroclor 1260	NA	NA	NA	NA	X	NA	NA	NA
Aluminum	X	X	NA	NA	X	X	X	NA
Arsenic	NA	NA	NA	NA	X	X	NA	NA
Barium	NA	NA	NA	NA	X	X	NA	NA
Beryllium	NA	NA	NA	NA	X	X	NA	NA
Cadmium	X	X	NA	NA	X	X	NA	NA
Chromium	X	X	X	X	X	X	X	NA
Cobalt	NA	NA	NA	NA	X	X	NA	NA
Copper	NA	NA	X	X	NA	NA	NA	NA
Lead	X	X	X	NA	X	X	NA	NA
Magnesium	X	X	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	X	X	NA	NA
Mercury	X	X	NA	NA	NA	NA	NA	NA
Selenium	X	NA	NA	NA	X	X	NA	NA
Silver	X	X	NA	NA	NA	NA	NA	NA
Vanadium	X	X	NA	NA	X	X	NA	NA
Zinc	X	X	NA	NA	X	NA	NA	NA

Notes: 1) NA - Not applicable. Chemical is not chemical of concern for this receptor.
2) X - Chemical of concern for this receptor.

TABLE 7-19

HAZARD QUOTIENTS FOR AQUATIC RECEPTORS
BASED ON MAXIMUM SURFACE WATER CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Aluminum	2.4E + 2
Cadmium	7.7E + 1
Barium	2.9E + 1
Zinc	2.7E + 1
Manganese	2.3E + 1
Cobalt	2.2E + 1
Mercury	1.6E + 1
Iron	1.1E + 1
Copper	6.1E + 0
Lead	4.1E + 0

TABLE 7-20

**HAZARD QUOTIENTS FOR AQUATIC RECEPTORS
BASED ON MEAN SURFACE WATER CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT**

Chemicals of Concern	Hazard Quotient
Aluminum	4.6E+1
Cadmium	9.6E+0
Barium	9.0E+0
Mercury	8.6E+0
Manganese	6.6E+0
Zinc	6.1E+0
Cobalt	4.6E+0
Iron	4.2E+0
Lead	1.8E+0
Copper	1.5E+0

TABLE 7-21

HAZARD QUOTIENTS FOR BENTHIC INVERTEBRATES
BASED ON MAXIMUM SEDIMENT CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Gamma-Chlordane	2.3E+2
4,4'-DDD	1.5E+2
Cyanide	6.1E+1
4,4'-DDT	5.6E+1
4,4'-DDE	4.3E+1
Dieldrin	3.1E+1
Heptachlor epoxide	7.2E+0
Phenanthrene	5.5E+0
Copper	4.7E+0
Endosulfan II	3.3E+0
Mercury	2.2E+0
Chromium	2.0E+0
Endosulfan sulfate	1.5E+0
Endosulfan I	1.5E+0
Arsenic	1.4E+0
Fluoranthene	1.3E+0
Heptachlor	1.3E+0
Methoxychlor	1.2E+0

TABLE 7-22

HAZARD QUOTIENTS FOR BENTHIC INVERTEBRATES
BASED ON MEAN SEDIMENT CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Gamma-Chlordane	1.0E+2
4,4'-DDD	1.5E+1
Cyanide	1.4E+1
Dieldrin	9.0E+0
Heptachlor epoxide	6.0E+0
4,4'-DDT	5.9E+0
4,4'-DDE	4.1E+0
Copper	3.5E+0
Mercury	1.5E+0
Methoxychlor	1.1E+0
Heptachlor	1.1E+0

TABLE 7-23

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Aluminum	3.6E+02
Chromium	1.0E+02
Vanadium	3.8E+01
Lead	2.6E+00
Zinc	2.5E+00
Cadmium	2.4E+00
Mercury	2.3E+00
Silver	2.3E+00
Selenium	1.5E+00

TABLE 7-24

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Aluminum	3.0E+2
Chromium	7.0E+1
Vanadium	2.7E+1
Cadmium	1.6E+0
Zinc	1.5E+0
Lead	1.1E+0
Mercury	1.1E+0
Silver	1.0E+0

TABLE 7-25

HAZARD QUOTIENTS FOR SOIL INVERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Chromium	4.8E+0
Lead	2.2E+0
Copper	2.1E+0

TABLE 7-26

HAZARD QUOTIENTS FOR SOIL INVERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern	Hazard Quotient
Chromium	2.8E+0
Copper	1.4E+0

TABLE 7-27
HAZARD QUOTIENTS FOR TERRESTRIAL VERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Aluminum	3.5E+2	45.9
	Vanadium	1.6E+2	20.9
	Chromium	1.2E+2	15.2
	Arsenic	3.1E+1	4.0
	All others	1.1E+2	14.0
	Total Receptor HI	7.7E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	4.3E+2	56.0
	Food	3.0E+2	39.5
	Water	3.5E+1	4.5
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	4,4'-DDD	4.8E+0	46.4
	Aluminum	1.7E+0	16.3
	Chromium	1.3E+0	12.2
Raccoon	Zinc	7.5E-1	7.2
	All others	1.8E+0	17.9
	Total Receptor HI	1.0E+1	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	5.8E+0	55.4
	Food	4.6E+0	43.8
	Water	8.9E-2	0.8
Raccoon	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	Vanadium	4.2E+0	30.6
	Heptachlor epoxide	2.6E+0	19.2
	Phenanthrene	1.2E+0	8.8
	Chromium	1.1E+0	7.9
	All others	4.6E+0	33.5
	Total Receptor HI	1.4E+1	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	1.2E+1	85.6
	Food	1.9E+0	14.0
	Water	5.3E-2	0.4

TABLE 7-27 (Continued)
HAZARD QUOTIENTS FOR TERRESTRIAL VERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Mallard	4,4'-DDD	2.8E+2	50.4
	4,4'-DDT	1.7E+2	30.5
	Heptachlor epoxide	5.0E+1	8.9
	4,4'-DDE	4.2E+1	7.6
	All others	1.5E+1	2.6
	Total Receptor HI	5.6E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	9.7E+1	17.5
	Food	4.6E+2	82.5
	Water	7.6E-2	0.0

TABLE 7-28
HAZARD QUOTIENTS FOR TERRESTRIAL VERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Vanadium	1.2E+2	41.0
	Chromium	6.8E+1	24.2
	Arsenic	2.5E+1	8.8
	Cobalt	1.8E+1	6.5
	All others	5.5E+1	19.5
	Total Receptor HI	2.8E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	1.6E+2	56.8
	Food	1.2E+2	40.7
	Water	7.1E+0	2.5
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	4,4'-DDD	1.5E+0	37.7
	Chromium	7.4E-1	18.5
	Cobalt	5.4E-1	13.5
Raccoon	Zinc	4.6E-1	11.4
	All others	7.6E-1	19.9
	Total Receptor HI	4.0E+0	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	2.2E+0	56.1
	Food	1.7E+0	43.4
	Water	2.0E-2	0.5
Raccoon	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	Vanadium	4.2E+0	47.7
	Heptachlor epoxide	2.2E+0	24.8
	Chromium	1.1E+0	12.4
	Boron	4.5E-1	5.0
	All others	8.9E-1	10.1
	Total Receptor HI	8.8E+0	
Raccoon	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	7.7E+0	86.8
	Food	1.2E+0	13.1
	Water	1.1E-2	0.1

TABLE 7-28 (Continued)
HAZARD QUOTIENTS FOR TERRESTRIAL VERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 2 - AREA A WETLAND
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Mallard	Heptachlor epoxide	4.2E+1	44.2
	4,4'-DDD	2.9E+1	30.6
	4,4'-DDT	1.8E+1	19.1
	4,4'-DDE	4.0E+0	4.3
	All others	1.7E+0	1.8
	Total Receptor HI	9.4E+1	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	1.6E+1	17.4
	Food	7.7E+1	82.6
	Water	1.7E-2	0.0



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NOTE
1 BASE MAP AND UTILITY INFORMATION
FROM MAPS OF NSB-NLON AND
PHASE II RI WORK PLAN (ATLANTIC,
MAY 1993)

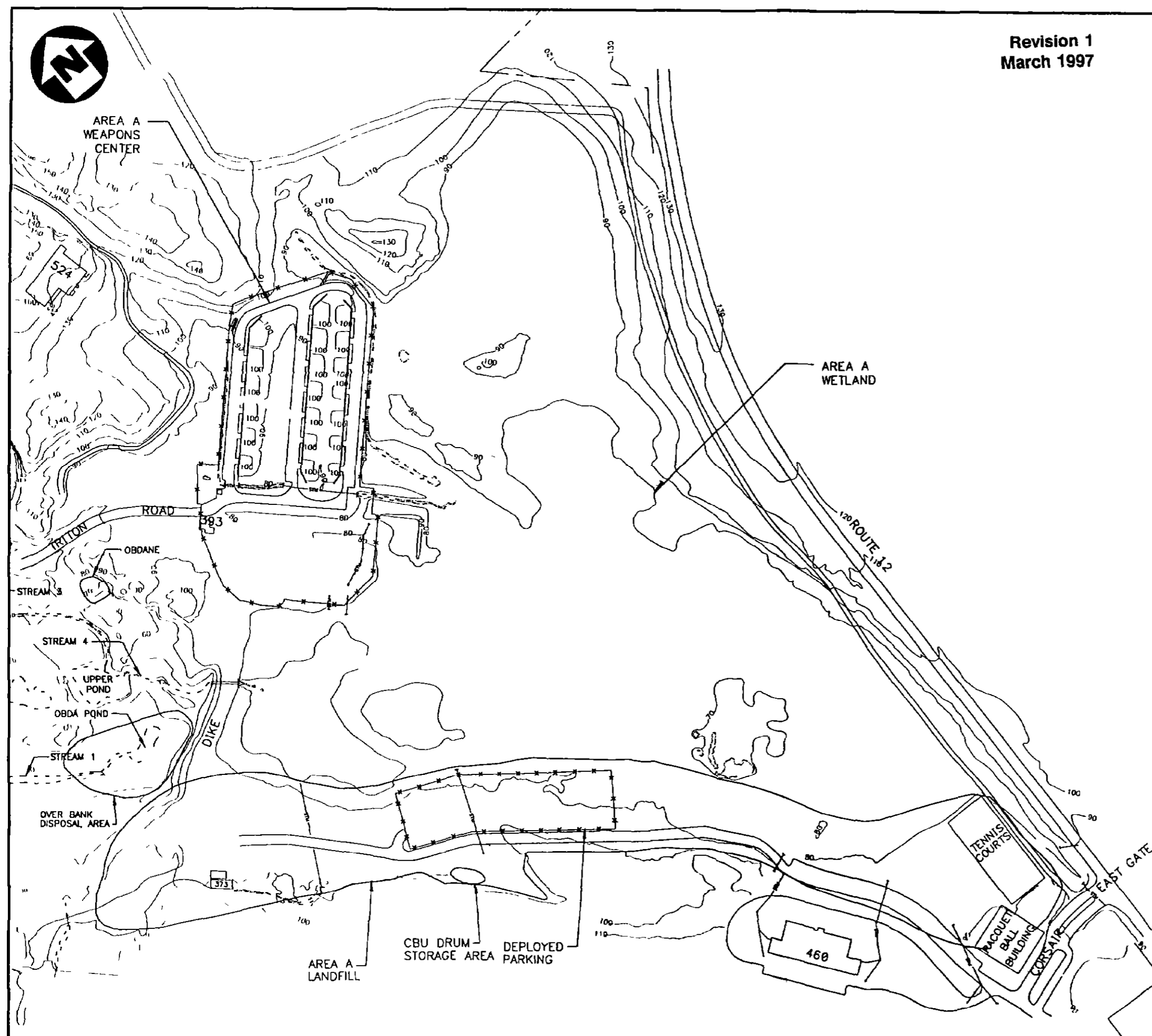


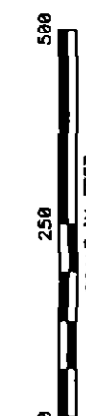
FIGURE 7-1
GENERAL SITE ARRANGEMENT
AREA A WETLAND



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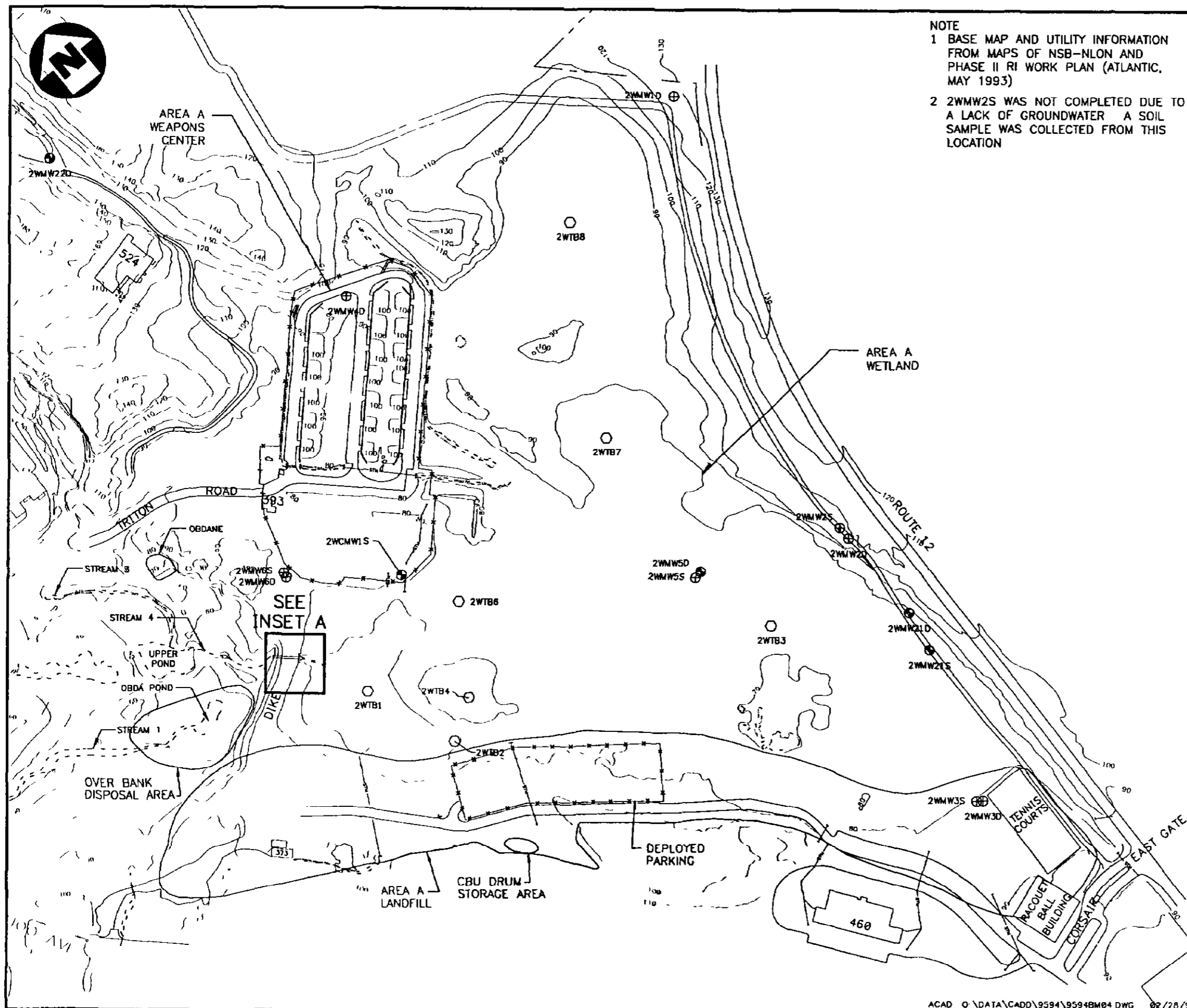
LEGEND

- EXISTING CONTOUR
- BUILDING No
- WATERCOURSE
- STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK
- FENCE

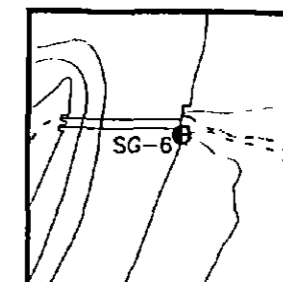


SCALE IN FEET

ACAD 0 \DATA\CADD\9594\9594BM06.DWG 02/23/96 MJJ



- NOTE
- 1 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
 - 2 2WMW2S WAS NOT COMPLETED DUE TO A LACK OF GROUNDWATER A SOIL SAMPLE WAS COLLECTED FROM THIS LOCATION



INSET A

0 100
SCALE IN FEET

LEGEND

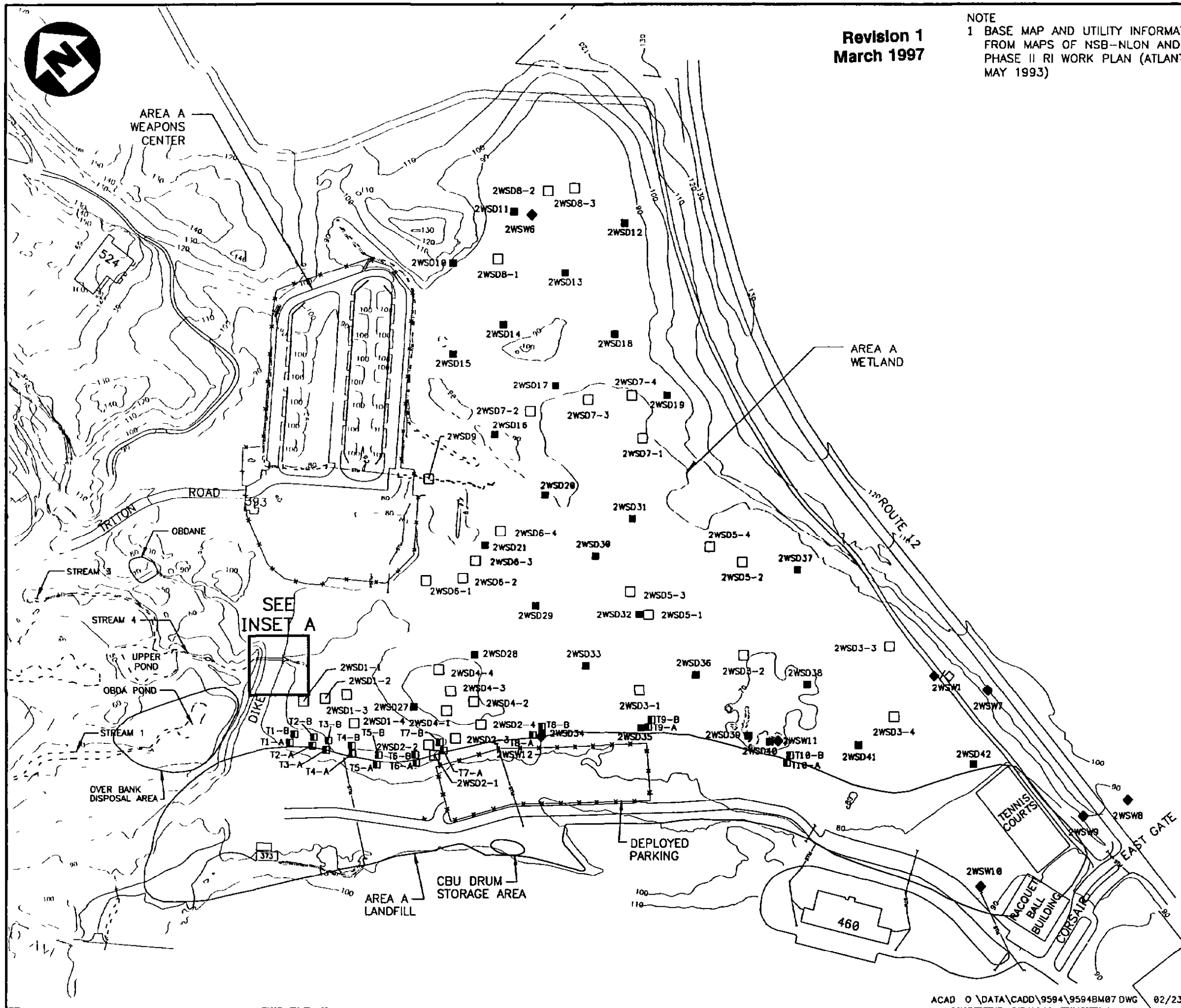
- | | | | |
|--------|--------------------------|-----|-----------------------------|
| 2WMW35 | PHASE I MONITORING WELL | 123 | EXISTING CONTOUR |
| 2WMW50 | PHASE II MONITORING WELL | --- | WATERCOURSE |
| 2WTB3 | PHASE I TEST BORING | --- | STORM SEWER AND CATCH BASIN |
| SC-6 | PHASE II STAFF GAUGE | --- | EXPOSED BEDROCK |
| | | --- | FENCE |

0 250 500
SCALE IN FEET

FIGURE 7-2
TEST BORING, WELL,
AND STAFF GAUGE LOCATIONS
AREA A WETLAND

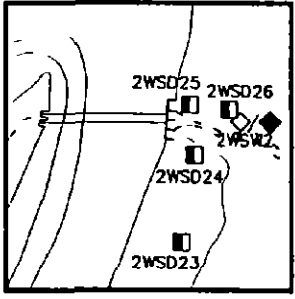
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NOTE
1 BASE MAP AND UTILITY INFORMATION
FROM MAPS OF NSB-NLON AND
PHASE II RI WORK PLAN (ATLANTIC,
MAY 1993)



INSET A

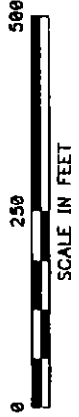


FIGURE 7-3
SURFACE SAMPLING LOCATIONS
AREA A WETLAND

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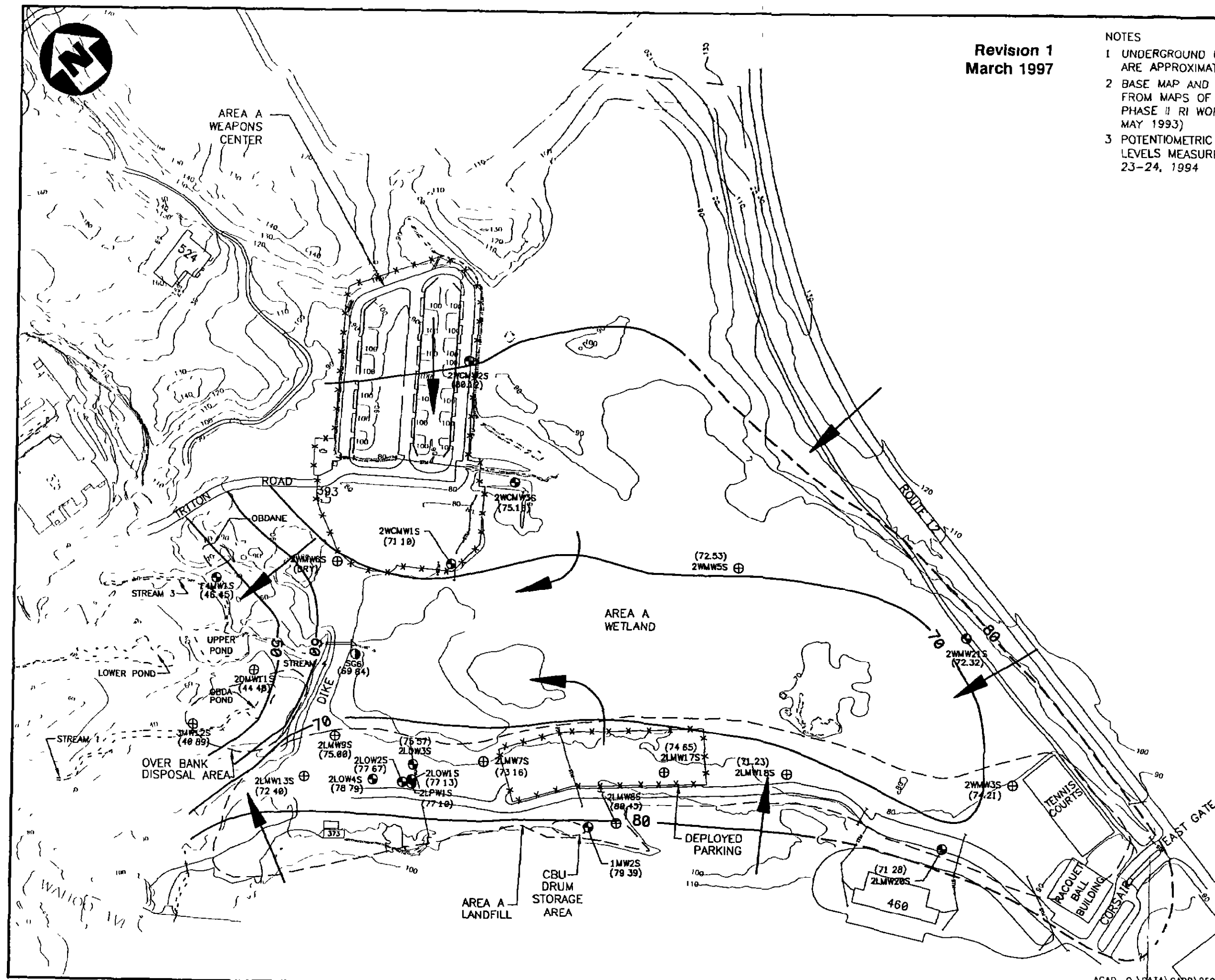
LEGEND

2WSD1-1	EXISTING CONTOUR
2WSD1-2	BUILDING NO
2WSD1-3	WATERCOURSE
2WSD1-4	STORM SEWER AND CATCH BASIN
2WSD1-5	EXPOSED BEDROCK
2WSD1-6	FENCE
2WSD1-7	PHASE I SEDIMENT SAMPLE
2WSD1-8	PHASE I SURFACE WATER SAMPLE
2WSD1-9	PHASE II SURFACE WATER SAMPLE
2WSD1-10	PHASE II SEDIMENT SAMPLE
2WSD1-11	FTS SEDIMENT SAMPLE



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PLOT LIMITS



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NOTES

- 1 UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE
- 2 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
- 3 POTENTIOMETRIC SURFACE FOR WATER LEVELS MEASURED ON AUGUST 23-24, 1994

FIGURE 7-4
SHALLOW OVERBURDEN
POTENTIOMETRIC SURFACE MAP
AREA A LANDFILL,
WETLAND, AND WEAPONS CENTER



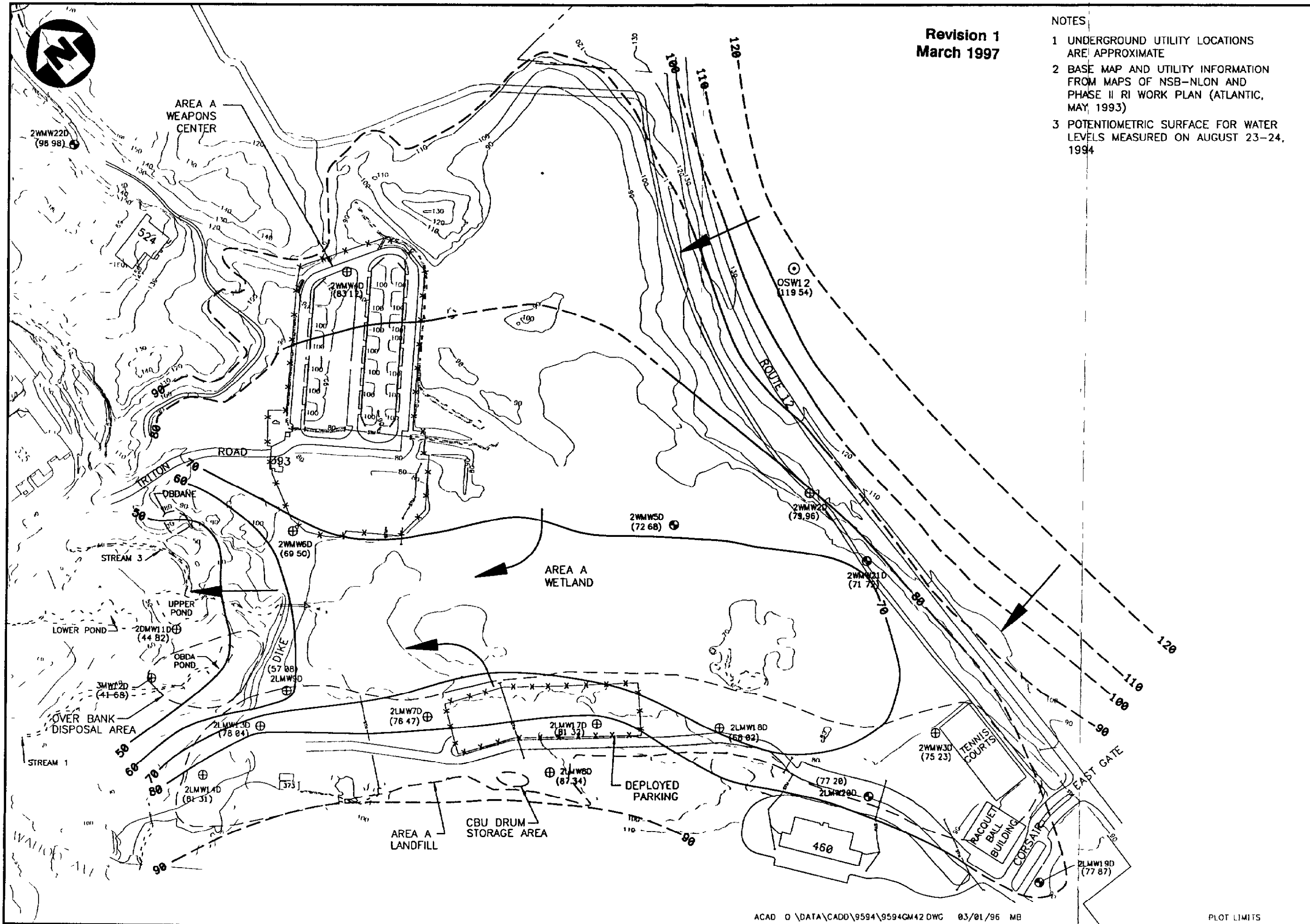
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LEGEND

- | | | | |
|---|--|-----|-----------------------------|
| ① | PHASE I MONITORING WELL | 10 | EXISTING CONTOUR |
| ② | PHASE II MONITORING WELL | 123 | BUILDING NO |
| ③ | PHASE II STAFF GAUGE | --- | WATERCOURSE |
| ④ | POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED) | --- | STORM SEWER AND CATCH BASIN |
| ⑤ | GROUNDWATER ELEVATION (ft MSL) | --- | EXPOSED BEDROCK |
| | | --- | GROUNDWATER FLOW DIRECTION |
| | | --- | FENCE |



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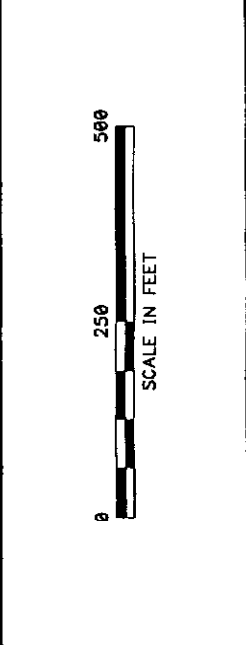


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- NOTES
- 1 UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE
 - 2 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
 - 3 POTENTIOMETRIC SURFACE FOR WATER LEVELS MEASURED ON AUGUST 23-24, 1994

FIGURE 7-5
BEDROCK
POTENTIOMETRIC SURFACE MAP
AREA A LANDFILL,
WETLAND, AND WEAPONS CENTER

- LEGEND
- | | | | |
|---------|--|-------|-----------------------------|
| ⊕ | PHASE I MONITORING WELL | --- | EXISTING CONTOUR |
| ⊙ | PHASE II MONITORING WELL | - - - | WATERCOURSE |
| ⊖ | RESIDENTIAL WELL | - - - | STORM SEWER AND CATCH BASIN |
| - - - | POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED) | | EXPOSED BEDROCK |
| (88 45) | GROUNDWATER ELEVATION (ft MSL) | * * * | FENCE |
| | | → | GROUNDWATER FLOW DIRECTION |





CPAH 2.16
NPAH 2.27
DDTR 0.18
AR-1260 ND

CPAH 0.40
NPAH 1.57
DDTR ND
AR-1260 0.37

CPAH 0.85
NPAH 0.98
DDTR 0.07
AR-1260 ND

CPAH 227.0
NPAH 184.4
DDTR ND
AR-1260 ND

CPAH 1.70
NPAH 3.24
DDTR ND
AR-1260 ND

CPAH 0.99
NPAH 1.48
DDTR ND
AR-1260 ND

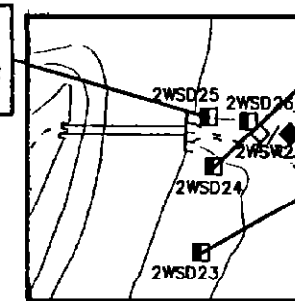
CPAH ND
NPAH 1.08
DDTR ND
AR-1260 ND

CPAH NA
NPAH NA
DDTR 8.42
AR-1260 ND

CPAH NA
NPAH NA
DDTR 3.34
AR-1260 ND

CPAH NA
NPAH NA
DDTR 0.69
AR-1260 ND

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INSET A

0 100 180
SCALE IN FEET

NOTE

1. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
2. ALL PAHs > 1.0 mg/kg, DDTR > 0.1 mg/kg AND POSITIVE DETECTIONS OF PCBs ARE SHOWN ON FIGURE
3. DDTR IS THE SUM OF DDD, DDT AND DDE
4. ND=NOT DETECTED
NA=NOT ANALYZED

CPAH 2.95
NPAH 2.64
DDTR 4.63
AR-1260 ND

CPAH 1.64
NPAH 1.60
DDTR 0.32
AR-1260 ND

CPAH 1.10
NPAH 1.10
DDTR 0.05
AR-1260 0.18

CPAH 0.32
NPAH 0.30
DDTR 0.01
AR-1260 0.15

CPAH 4.19
NPAH 4.94
DDTR 0.74
AR-1260 ND

CPAH 14.00
NPAH 12.87
DDTR 1.54
AR-1260 ND

CPAH ND
NPAH 1.06
DDTR 0.06
AR-1260 ND

CPAH 1.36
NPAH 1.29
DDTR ND
AR-1260 ND

CPAH 1.01
NPAH 1.23
DDTR 0.68
AR-1260 ND

CPAH 1.80
NPAH 2.13
DDTR 0.30
AR-1260 ND

LEGEND

- 10- EXISTING CONTOUR
- 123- BUILDING No
- WATERCOURSE
- STW- STORM SEWER
- CATCH BASIN
- EXPOSED BEDROCK
- FENCE
- 2WSD7-1 PHASE I SEDIMENT SAMPLE
- 2WSW1 PHASE I SURFACE WATER SAMPLE
- 2WSW6 PHASE II SURFACE WATER SAMPLE
- 2WSD12 PHASE II SEDIMENT SAMPLE
- 2WSD25 PHASE II SEDIMENT SAMPLE
- 2WSD26 PHASE II SEDIMENT SAMPLE
- 2WSD27 PHASE II SEDIMENT SAMPLE
- 2WSD28 PHASE II SEDIMENT SAMPLE
- 2WSD29 PHASE II SEDIMENT SAMPLE
- 2WSD30 PHASE II SEDIMENT SAMPLE
- 2WSD31 PHASE II SEDIMENT SAMPLE
- 2WSD32 PHASE II SEDIMENT SAMPLE
- 2WSD33 PHASE II SEDIMENT SAMPLE
- 2WSD34 PHASE II SEDIMENT SAMPLE
- 2WSD35 PHASE II SEDIMENT SAMPLE
- 2WSD36 PHASE II SEDIMENT SAMPLE
- 2WSD37 PHASE II SEDIMENT SAMPLE
- 2WSD38 PHASE II SEDIMENT SAMPLE
- 2WSD39 PHASE II SEDIMENT SAMPLE
- 2WSD40 PHASE II SEDIMENT SAMPLE
- 2WSD41 PHASE II SEDIMENT SAMPLE
- 2WSD42 PHASE II SEDIMENT SAMPLE
- 2WSW7 PHASE II SURFACE WATER SAMPLE
- 2WSW8 PHASE II SURFACE WATER SAMPLE
- 2WSW9 PHASE II SURFACE WATER SAMPLE
- 2WSW10 PHASE II SURFACE WATER SAMPLE
- 2WSW11 PHASE II SURFACE WATER SAMPLE
- 2WSW12 PHASE II SURFACE WATER SAMPLE
- 2WSW13 PHASE II SURFACE WATER SAMPLE
- 2WSW14 PHASE II SURFACE WATER SAMPLE
- 2WSW15 PHASE II SURFACE WATER SAMPLE
- 2WSW16 PHASE II SURFACE WATER SAMPLE
- 2WSW17 PHASE II SURFACE WATER SAMPLE
- 2WSW18 PHASE II SURFACE WATER SAMPLE
- 2WSW19 PHASE II SURFACE WATER SAMPLE
- 2WSW20 PHASE II SURFACE WATER SAMPLE
- 2WSW21 PHASE II SURFACE WATER SAMPLE
- 2WSW22 PHASE II SURFACE WATER SAMPLE
- 2WSW23 PHASE II SURFACE WATER SAMPLE
- 2WSW24 PHASE II SURFACE WATER SAMPLE
- 2WSW25 PHASE II SURFACE WATER SAMPLE
- 2WSW26 PHASE II SURFACE WATER SAMPLE
- 2WSW27 PHASE II SURFACE WATER SAMPLE
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- 2WSW38 PHASE II SURFACE WATER SAMPLE
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- 2WSW40 PHASE II SURFACE WATER SAMPLE
- 2WSW41 PHASE II SURFACE WATER SAMPLE
- 2WSW42 PHASE II SURFACE WATER SAMPLE
- 2WSW43 PHASE II SURFACE WATER SAMPLE
- 2WSW44 PHASE II SURFACE WATER SAMPLE
- 2WSW45 PHASE II SURFACE WATER SAMPLE
- 2WSW46 PHASE II SURFACE WATER SAMPLE
- 2WSW47 PHASE II SURFACE WATER SAMPLE
- 2WSW48 PHASE II SURFACE WATER SAMPLE
- 2WSW49 PHASE II SURFACE WATER SAMPLE
- 2WSW50 PHASE II SURFACE WATER SAMPLE
- 2WSW51 PHASE II SURFACE WATER SAMPLE
- 2WSW52 PHASE II SURFACE WATER SAMPLE
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- 2WSW68 PHASE II SURFACE WATER SAMPLE
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- 2WSW70 PHASE II SURFACE WATER SAMPLE
- 2WSW71 PHASE II SURFACE WATER SAMPLE
- 2WSW72 PHASE II SURFACE WATER SAMPLE
- 2WSW73 PHASE II SURFACE WATER SAMPLE
- 2WSW74 PHASE II SURFACE WATER SAMPLE
- 2WSW75 PHASE II SURFACE WATER SAMPLE
- 2WSW76 PHASE II SURFACE WATER SAMPLE
- 2WSW77 PHASE II SURFACE WATER SAMPLE
- 2WSW78 PHASE II SURFACE WATER SAMPLE
- 2WSW79 PHASE II SURFACE WATER SAMPLE
- 2WSW80 PHASE II SURFACE WATER SAMPLE
- 2WSW81 PHASE II SURFACE WATER SAMPLE
- 2WSW82 PHASE II SURFACE WATER SAMPLE
- 2WSW83 PHASE II SURFACE WATER SAMPLE
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- 2WSW91 PHASE II SURFACE WATER SAMPLE
- 2WSW92 PHASE II SURFACE WATER SAMPLE
- 2WSW93 PHASE II SURFACE WATER SAMPLE
- 2WSW94 PHASE II SURFACE WATER SAMPLE
- 2WSW95 PHASE II SURFACE WATER SAMPLE
- 2WSW96 PHASE II SURFACE WATER SAMPLE
- 2WSW97 PHASE II SURFACE WATER SAMPLE
- 2WSW98 PHASE II SURFACE WATER SAMPLE
- 2WSW99 PHASE II SURFACE WATER SAMPLE
- 2WSW100 PHASE II SURFACE WATER SAMPLE

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0 250 500
SCALE IN FEET

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FIGURE 7-6
PAHs, DDTR, AND PCBs IN SURFACE
SOIL AND SEDIMENT (mg/kg)
AREA A WETLAND

CPAH 1.34
NPAH 1.83
DDTR 1.74
AR-1260 ND

CPAH 1.13
NPAH 1.18
DDTR 0.45
AR-1260 0.53

CPAH 2.16
NPAH 2.15
DDTR 0.02
AR-1260 1.50

CPAH 1.91
NPAH 2.37
DDTR 0.14
AR-1260 0.55

CPAH 2.47
NPAH 2.13
DDTR ND
AR-1260 0.08

CPAH 2.18
NPAH 2.67
DDTR 0.11
AR-1260 ND

CPAH 1.27
NPAH 1.30
DDTR ND
AR-1260 ND

8.0 SITE 20 - AREA A WEAPONS CENTER

This section provides a site-specific summary of various aspects of the Area A Weapons Center investigation. Section 8.1 provides a brief site description. The sampling and analysis program is summarized in Section 8.2. Section 8.3 discusses site physical features. The nature and extent of contamination is discussed in Section 8.4. Contaminant fate and transport is summarized in Section 8.5. Section 8.6 provides the baseline human health risk assessment and Section 8.7 presents the ecological risk assessment. Section 8.8 includes a comparison to state standards and Section 8.9 provides a summary and conclusions.

8.1 SITE DESCRIPTION

The Area A Weapons Center site consists of Building 524 and weapons storage bunkers. The storage bunker area is divided into two portions (north and south areas) which were constructed at different times and are of different design. The site is located at the southeast end of Triton Avenue and is adjacent to and on the northwest side of the Area A Wetland. The general configuration of the Area A Weapons Center site is shown in Figure 8-1. The location of the site within the NSB-NLON is shown on Drawing Number 1 (Volume III). Current photos of the site are provided in Appendix B.3.

The Area A Weapons Center (Building 524) is located near the top of a local topographic and bedrock high. Building 524 was constructed in 1990-1991. Portions of the site were blasted to remove bedrock to accommodate construction of the building. The weapons storage bunkers are located southeast and downhill of Building 524 and are adjacent to and at a slightly higher elevation than the Area A Wetland.

Prior to construction of the Area A Weapons Center, the site consisted of woodlands in the vicinity of Building 524 and Area A Wetland in the bunker areas. Based on review of aerial photographs, the southern area of weapons storage bunkers was first evident in 1969. The northern area of weapons storage bunkers was first evident in February 1974.

Atlantic personnel inspected the Area Weapons Center on September 11, 1992. The following information was obtained during the site inspection. Building 524 is used for administration, minor torpedo assembly, and storage of simulator torpedoes. No weapons production takes place in this building. Small quantities of chemicals and chemical waste generated by activities in this building are stored in 1- to 5-gallon containers in seven metal storage cabinets located on a paved area to the south of the building. Chemicals

include cleaning and lubricating compounds, paints, and adhesives. Many of these materials are classified as corrosive or flammable materials. The waste storage and management practices appeared to be good.

The weapons storage bunkers are located southeast of Building 524. Liquid fuels in the weapons storage bunkers include Otto fuel, JP-10, and TH Dimer (kerosene). The group of southern area bunkers have been reconstructed in the last 10 years. A major part of the reconstruction involved removal of structurally unsuitable soil from the site. The removed materials appeared to be dredge spoils associated with the Area A Wetland. Prior to offsite disposal, these materials and the excavation sidewalls and groundwater were sampled and analyzed. Two sidewall samples and one groundwater sample were collected from the excavation. Four samples of the excavated materials were collected from the stockpile. Samples were analyzed for metals, volatile organics, PAHs, PCBs, cyanide, 4,4'-DDT, and TPH. Cyanide, TPH, and various metals were detected in the samples. Other analytes were not detected.

Routine maintenance and security improvements that are planned for the Area A Weapons Center include grouting and waterproofing of bunkers, repaving of roads, installation of culverts, and regrading associated with these activities.

8.2 SITE INVESTIGATIONS

Section 2.0 included a detailed discussion of the sampling procedures and analytical methods used during investigations at NSB-NLON. Sample locations for the Phase II RI are depicted on Figure 8-2. The remainder of this section discusses the scope of the Phase I and II RIs.

8.2.1 Phase I RI

This site was not investigated during the Phase I RI. Although samples were obtained in the vicinity of the site, these samples were collected as part of the Area A Wetland investigation. Two of these samples (2WGW4D and 2WMW4 from 0 to 2 feet) are discussed in this section, even though their locations were originally selected during the wetland investigation. One groundwater sample was collected from well 2WMW4D. Well 2WMW4S was not completed due to a lack of significant groundwater in the shallow overburden. One surface soil sample 2WMW4 (0 to 2 feet) was collected from the boring 2WMW4S. Table 8-1 provides a summary of the analytical program for these samples.

8.2.2 Phase II RI

Ten soil samples (plus two field duplicate samples) were collected from two monitoring well borings and eight test borings. Three samples (plus one field duplicate) were collected from depths of less than 2 feet (i.e., surface soils). Seven samples (plus one field duplicate) were collected from depths between 2 and 18 feet (i.e., subsurface soils).

Three new shallow overburden groundwater wells were installed and sampled. Additionally, the deep (bedrock) well 2WMW4D from the Phase I RI was sampled. Two rounds of groundwater samples were collected and four samples (plus one field duplicate during Round 1 only from well 2WCMW1S) were collected during each sampling round.

During the Phase II RI, fifteen sediment samples (plus one field duplicate sample) were collected at this site. The sediment samples were collected from three distinct drainage areas, as shown on Figure 8-3, which will be referred to as drainage areas one, two, and three. Two surface water samples were also collected from stormwater drainageways at the Area A Weapons Center. Sample 2WCSW3 was collected from Drainage Area 3, and 2WCSW5 was collected from Drainage Area 2. All sample locations are shown on Figures 8-2 and 8-3. Table 8-2 provides a sample-specific summary of the Phase II sampling and analytical program.

8.3 PHYSICAL CHARACTERISTICS

This section presents a summary of site physical characteristics for the Area A Weapons Center based on information generated during the Phase I and Phase II RIs. Topography and surface features, surface water, soils, geology, and hydrogeology are discussed in the subsections that follow.

8.3.1 Topography and Surface Features

Figure 8-1 shows the topography and surface features of the Area A Weapons Center. The site consists of Building 524 and weapons storage bunkers. The Area A Weapons Center is located near the top of the northern topographic and bedrock high. The ground surface generally slopes from the northern bedrock high to the south toward the Area A Wetland. The 90-foot ground surface contour surrounds the site. The shape of this contour is consistent with the topography on the historical surficial geology map (USGS, 1960). The ground surface across the Area A Weapons Center is relatively flat. It has been altered as the bedrock was blasted during construction of Building 524. To the west and southwest, the ground surface slopes to a ravine (Area A Downstream Watercourses) and toward the OBDANE.

8.3.2 Surface Water Features (Atlantic, August 1992)

Two drainage culverts (one along the northwest side and one along the southeast side of the site) collect runoff from the surrounding hillsides and from the Area A Weapons Center and discharge it to the Area A Wetland. The drainage culvert along the northwest side eventually discharges to a storm sewer which passes along the southern side of the site and discharges into the Area A Wetland (Drainage Area 1). The drainage culvert along the southeast side collects runoff from the hillside north of the site and continues along the southeast side of the site, eventually discharging to the Area A Wetland (Drainage Area 2). The Area A Wetland discharges to the Area A Downstream Watercourses and subsequently into the Thames River. Water typically flows in these drainage culverts immediately following precipitation occurrences.

8.3.3 Soil Characteristics

The SCS Soils Map (SCS, 1983) classifies the soil at the Area A Weapons Center as Udorthents-Urban land. This soil type is defined as excessively to moderately drained soils that have been disturbed by cutting and filling. The bedrock surface has been altered by blasting in some areas of the site. Other areas have been filled with dredge spoils. Native soils at the Area A Weapons Center were likely the same as those along the northern bedrock high. The SCS Map classifies this soil as the Hollis-Charlton-Rock complex, which is defined as stones and boulders intermingled with a dark, fine, sandy loam. Bedrock outcrops are prevalent.

8.3.4 Geology

The overburden materials at the Area A Weapons Center consist of 4 to 16 feet of coarse sand, gravel, and rock fill that is underlain by up to 17 feet of fine-grained dredge spoils. At the 2WCTB1 and 2WCTB4 test boring locations, 8 and 4 feet, respectively, of fill material rests directly on bedrock (Mamacoke Formation). These are the only test borings where the bedrock was encountered and dredge spoils were not present. The overburden thickness generally increases to the south and east, toward the Area A Wetland. The bedrock topography across the Area A Weapons Center is depicted on Drawing 4 (Volume III). Geologic conditions are shown on cross-sections E-E' and F-F' on Drawings 19 and 20, respectively (Volume III).

The bedrock surface generally slopes to the southwest across the site, toward the valley occupied by the Area A Wetland. The bedrock elevations at the 2WCTB1 and 2WCTB4 test borings are higher than at the 2WCTB6 test boring, which indicates that the bedrock surface does not slope uniformly and that localized bedrock surface depression(s) are present. This identified depression is most likely the result of the blasting activities that occurred during the construction of the Area A Weapons Center. The historical surficial

geology map (USGS, 1960) indicates that, formerly, the bedrock rose steeply to the 2WCTB1 and 2WCTB4 test borings and then rose gently to 2WCTB6 test boring.

8.3.5 Hydrogeology

Groundwater is present in both the overburden and bedrock underlying the Area A Weapons Center. The saturated thickness of the overburden deposits is variable, ranging up to 25 feet or more. Overburden groundwater is primarily found within the dredge spoil materials, with only the lowermost few feet of the coarser-grained fill deposits saturated. Figure 8-4 shows shallow overburden groundwater contours for the Area A Weapons Center and nearby areas. Figure 8-5 shows bedrock groundwater contours for the same areas. Groundwater in both the overburden and bedrock flows across the weapons center to the southwest. Cross-section E-E' shows the groundwater flow from the Area A Weapons Center toward the Area A Landfill. Cross-section F-F' shows the groundwater flow from the Area A Weapons Center toward the OBDANE. Although monitoring well 2WMW6S was dry during the August round of data collection, the March data indicate a downward gradient between 2WMW6S and 2WMW6D, indicating downward flow from the overburden to the bedrock in this area.

The shallow overburden hydraulic gradient across the Area A Weapons Center is 0.019. Assuming an average horizontal hydraulic conductivity of 2.7 feet/day or 9.5×10^{-4} cm/sec (based on the Area A Landfill pumping test) and a porosity of 0.30, the seepage velocity for this area is estimated to be about 0.17 feet/day. The bedrock flow gradient is similar to the overburden gradient; however, there is not sufficient data available regarding bedrock permeability and porosity to calculate flow velocities within the bedrock.

8.3.6 Ecological Habitat

The Area A Weapons Center is well-developed and characterized by buildings, weapons storage bunkers, paved areas between the bunkers and maintained lawns. While drainage ditches collect surface water runoff from this area, these ditches typically do not contain standing water for any extended period of time and do not support an aquatic community. This site does not provide habitat for wildlife receptors. However, the Area A Weapons Center is adjacent to three areas that do represent potential habitat. An upland coniferous/deciduous forest, characterized by red/black oak, eastern hemlock, white oak, black birch, mockernut hickory, mountain laurel, mapleleaf viburnum, and sassafras lies to the north of the Area A Weapons Center. A small area classified as upland deciduous forest/shrub habitat lies to the east, as does the Area A Wetland. The upland deciduous forest/shrub habitat is dominated by black birch, black cherry,

red maple, gray birch, red cedar, blackberry, American bittersweet, and multiflora rose (Atlantic, 1992). The ecology of the Area A Wetland is described in Section 7.3.6.

8.4 NATURE AND EXTENT OF CONTAMINATION

This section contains a summary of the chemical analytical results for samples collected during the Phase I and Phase II RIs at the Area A Weapons Center. The complete analytical data base (chemical and engineering) is contained in Appendix D.4.

8.4.1 Soil

Positive analytical results for all Phase I and Phase II RI soil samples are provided in Table 8-3. Table 8-4 presents the TCLP results for soil samples. The analytical results are summarized in Table 8-5. Soil samples were also collected for field analyses using an organic vapor detector to determine appropriate samples to send to the laboratory for fixed base analyses. The field analytical results are summarized in Table 8-6.

A few volatile organics were detected in the subsurface soil samples. The concentrations were relatively low, with the maximum detected concentrations being 690 $\mu\text{g/kg}$ and 240 $\mu\text{g/kg}$ (acetone and 2-butanone in an 8- to 10-foot-deep sample from 2WCTB6). All other volatile organics were at concentrations of 11 $\mu\text{g/kg}$ or less. Therefore, the analytical results do not indicate significant volatile organic contamination at this site.

Semivolatile organics, particularly PAHs, were more frequently detected and were quantitated at higher concentrations than the volatile organics. The surface soil sample collected from boring 2WCTB2, located southwest of the bunkers along Triton Road, contained the highest concentrations of PAHs. For example, this sample contained fluoranthene (5,700 $\mu\text{g/kg}$), phenanthrene (4,200 $\mu\text{g/kg}$), pyrene (4,000 $\mu\text{g/kg}$), benzo(b)fluoranthene (3,200 $\mu\text{g/kg}$), and chrysene (2,300 $\mu\text{g/kg}$). The concentrations of PAHs decreased with depth in all samples collected. For instance, the maximum concentration of any PAH in the subsurface soil samples was 500 $\mu\text{g/kg}$ (pyrene in the 8- to 10-foot-deep sample from boring 2WCTB6, located in the central part of the complex). The concentrations of noncarcinogenic and carcinogenic PAHs in the surface soil samples (less than 2 feet deep) are presented in Figure 8-6.

A few phthalate esters were also detected in several of the subsurface soil samples and in the surface soil sample from boring 2WMW4. These compounds were generally detected less frequently than the PAHs and at lower concentrations. Carbazole (720 $\mu\text{g/kg}$) was also detected in the surface soil sample from boring 2WCTB2, and dibenzofuran (84 $\mu\text{g/kg}$ and 31 $\mu\text{g/kg}$, respectively) was detected in the surface soil samples

from borings 2WCTB2 and 2WCTB1. Benzoic acid, ranging in concentration from 47 $\mu\text{g/kg}$ to 480 $\mu\text{g/kg}$, was detected in 5 of 7 subsurface soil samples.

A few pesticides were detected in the surface soil samples. Endrin at a maximum concentration of 14 $\mu\text{g/kg}$ in two samples, 4,4'-DDE was detected in one sample at a concentration of 7.4 $\mu\text{g/kg}$, and endrin aldehyde at a concentration of 7 $\mu\text{g/kg}$ in one sample. Maximum concentrations of these three pesticides were detected in the surface sample from boring 2WCTB2 along Triton Road. Endrin aldehyde was also detected at a concentration of 6.4 $\mu\text{g/kg}$ in one of four subsurface soil samples. Aroclor-1260 was detected at a concentration of 50 $\mu\text{g/kg}$ in the Phase I RI surface soil sample 2WMW4 (0 to 2 feet).

With the exception of boron, maximum concentrations of all metals detected in surface soils were found in either boring 2WCTB1 or boring 2WCTB2. The maximum concentrations observed in the subsurface soils were often greater than those reported in the surface soils, with the maximum often reported in the 4- to 6-foot sample from boring 2WCTB3. Concentrations of antimony, barium, cadmium, calcium, manganese, nickel, potassium, sodium, and zinc exceeded NSB-NLON background levels in at least one surface soil sample, while concentrations of all metals detected in subsurface soils exceeded NSB-NLON background in at least one subsurface sample.

Barium was detected in the TCLP leachate of a surface soil sample from boring 2WMW4, while arsenic, barium, chromium, and selenium were detected in the TCLP leachate of subsurface sample 2WCTB5-0608. All TCLP results were below Federal toxicity characteristic regulatory levels and Connecticut remediation standards for pollutant mobility for GB waters.

8.4.2 Groundwater

Positive analytical results for all groundwater samples are provided in Table 8-7. The Phase I RI analytical results are summarized in Table 8-8. Tables 8-9 and 8-10 summarize the Phase II RI analytical results.

A limited number of organic chemicals were detected in the wells at the Area A Weapons Center. Most of the detections were in well 2WMW4D. The compounds detected in this deep well include ketones, halogenated aliphatics, phthalate esters, and benzoic acid. All detections were 12 $\mu\text{g/L}$ or less. During Round 1 of the Phase II RI, 1,3-dichlorobenzene was detected at a concentration of 0.6 $\mu\text{g/L}$ in well 2WCMW1S. Benzo(g,h,i)perylene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected at concentrations of 0.8 $\mu\text{g/L}$ to 1 $\mu\text{g/L}$ in well 2WCMW1S during Round 2 of the Phase II RI. During the

Phase I and II RIs, bis(2-ethylhexyl)phthalate was detected at a maximum concentration of 3 $\mu\text{g/L}$ in five samples.

The samples collected from well 2WCMW3S, located south of the site along the drainageway into the Area A Wetland (Drainage Area 1), contained the highest concentrations of many of the metals. Notable detections in the groundwater include arsenic ($C_{\text{max}} = 19.9 \mu\text{g/L}$), boron ($C_{\text{max}} = 3,810 \mu\text{g/L}$), manganese ($C_{\text{max}} = 6,540 \mu\text{g/L}$) and sodium ($C_{\text{max}} = 3,580,000 \mu\text{g/L}$).

Gross alpha and gross beta were detected in samples collected from deep well 2WMW4D at maximum concentrations of 20 pCi/L and 22 pCi/L, respectively, in Round 2 of the Phase II RI. Complete gamma spectrum analyses performed for samples from this well during Rounds 1 and 2 of the Phase II RI detected no radionuclides.

8.4.3 Surface Water

The analytical results for surface water samples are presented in Table 8-11. Di-n-octylphthalate and butylbenzylphthalate were the only organic compounds detected. Both of these compounds were found in sample 2WCSW3 (at concentrations of 1 $\mu\text{g/L}$ and 2 $\mu\text{g/L}$, respectively). Arsenic (2.6 $\mu\text{g/L}$) cadmium (6.6 $\mu\text{g/L}$), and zinc (135 $\mu\text{g/L}$) were detected in unfiltered sample 2WCSW3. These metals were also detected at similar concentrations in the filtered sample from the same location but were not detected in sample 2WCSW5. The maximum concentrations of all other detected metals (including barium, calcium, iron, lead, magnesium, manganese, and sodium) were detected in sample 2WCSW5.

8.4.4 Sediment

Positive results for all sediment samples are presented in Table 8-12. TCLP results are presented in Table 8-13. The analytical results for each of the three drainage areas are summarized in Table 8-14.

Drainage area 1 includes from upstream to downstream, samples 2WCSD1, 2WCSD2, 2WCSD3, 2WCSD11, 2WCSD14, and 2WCSD15. Three of these samples were analyzed for volatiles and pesticides. Toluene and methylene chloride were the only volatile organic chemicals detected in these samples (at concentrations of 2 $\mu\text{g/kg}$ and 12 $\mu\text{g/kg}$, respectively). These data do not indicate a significant volatile organic problem. Several pesticides, (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan sulfate, endrin, and heptachlor), were detected at concentrations ranging from 2.8 $\mu\text{g/kg}$ to 32 $\mu\text{g/kg}$. PAHs were the most prevalent contaminants, with maximum concentrations found in samples 2WCSD3 (midstream) and 2WCSD14 (downstream). Both

carcinogenic and noncarcinogenic PAHs were detected at concentrations as high as 6,900 $\mu\text{g/kg}$ (fluoranthene and pyrene). The concentrations of noncarcinogenic and carcinogenic PAHs are presented on Figure 8-6. Several phthalate esters were also detected, primarily in sample 2WCSD11, including bis(2-ethylhexyl)phthalate, di-n-butylphthalate, di-n-octylphthalate, and butylbenzylphthalate. The concentrations of phthalate esters ranged from 26 $\mu\text{g/kg}$ to 1,100 $\mu\text{g/kg}$. The maximum concentrations of metals were found in various locations, with downstream sample 2WCSD14 containing a majority of the maxima. Notable concentrations of metals include lead ($C_{\text{max}} = 127 \text{ mg/kg}$) manganese ($C_{\text{max}} = 1,480 \text{ mg/kg}$), and zinc ($C_{\text{max}} = 274 \text{ mg/kg}$). Barium was detected in the TCLP leachate of sample 2WCSD2 at a level below both Federal toxicity characteristic regulatory levels and Connecticut remediation standards for pollutant mobility.

Drainage area 2 includes, from upstream to downstream, samples 2WCSD10, 2WCSD9, 2WCSD8, and 2WCSD12. None of these samples were analyzed for volatile organics or pesticides/PCBs. PAHs and benzoic acid were the only semivolatile organics found in these samples. The PAHs were found at much lower concentrations than in the other drainage areas, with a maximum concentration of 660 $\mu\text{g/kg}$ (chrysene). In this area, the higher concentrations were primarily found in the most upstream sample (2WCSD10), although some maximum concentrations were also found in the most downstream sample (2WCSD12). Maximum individual metals concentrations varied from sample to sample, with no consistently higher concentrations at any location. Concentrations of metals detected in this area were also generally lower than concentrations detected in the other two areas (although most were only slightly lower).

Drainage area 3 includes samples 2WCSD4, 2WCSD5, 2WCSD6, 2WCSD7, and 2WCSD13, all collected southwest (downstream) of the site in the Area A Wetland. While a few volatile organic chemicals were detected in these samples, the data do not indicate a significant volatile organic problem. For example, trichloroethene and methylene chloride were detected at maximum concentrations of 22 $\mu\text{g/kg}$. Toluene, tetrachloroethane, and 1,1,1-trichloroethane (ranging from 4 $\mu\text{g/kg}$ to 13 $\mu\text{g/kg}$) were also detected in 2WCSD5. Again, PAHs were the predominant contaminants, with concentrations as high as 5,200 $\mu\text{g/kg}$ (pyrene). Sample 2WCSD4, followed by 2WCSD7, generally contained the highest concentrations in this area. Both carcinogenic and noncarcinogenic PAHs were detected. Di-n-octylphthalate, benzoic acid, carbazole, and dibenzofuran were also detected in from one to three sediment samples in this area. Several pesticides were also detected in samples 2WCSD4 and 2WCSD5. The maximum concentration of pesticides was 140 $\mu\text{g/kg}$ (endrin aldehyde), followed by 4,4'-DDT (60 $\mu\text{g/kg}$). The maximum concentrations of most metals in this area were found at locations 2WCSD5 and 2WCSD6. Notable concentrations of metals include cadmium ($C_{\text{max}} = 29.5 \text{ mg/kg}$), lead ($C_{\text{max}} = 204 \text{ mg/kg}$), manganese ($C_{\text{max}} = 2,640 \text{ mg/kg}$), and zinc ($C_{\text{max}} = 292 \text{ mg/kg}$).

Barium was detected in the TCLP leachate of sediment sample 2WCSD2. The reported concentration of this chemical, 0.248 mg/L, was less than the Federal toxicity characteristic regulatory level (100 mg/L) and the Connecticut remediation standard for pollutant mobility for GB waters (10 mg/L).

8.5 CONTAMINANT FATE AND TRANSPORT

The primary classes of contaminants identified at the Area A Weapons Center are PAHs and phthalate esters. These chemicals are typically less soluble than volatile organics and therefore are most likely to migrate via erosional processes. No PAHs were detected in the surface water samples, and relatively low concentrations of PAHs (i.e., slightly above the method detection limits) were detected in one groundwater sample (2WCGW1S-2). Figure 8-6 indicates that PAHs have been transported from the site via the drainage channels. Although a general downstream migration is indicated, the sediment results are somewhat discontinuous. Some of the highest concentrations of PAHs were noted in samples 2WCSD3 and 2WCSD14, which are located in Drainage Area 1. Although concentrations of PAHs are similar in these two samples, sample 2WCSD11, collected from a location between locations 2WCSD3 and 2WCSD14, had very low concentrations of PAHs.

PAHs appear to originate from Drainage Areas 1 and 3. Sediments from these areas are carried to downstream locations which eventually discharge into the Area A Wetland. Drainage Area 2 contains low concentrations of PAHs, and therefore it appears as though the source of PAHs is activity in and runoff/discharge from the northern and western portions of the Area A Weapons Center.

8.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the site-specific human health risk assessment for potential exposures occurring at the Area A Weapons Center. The methodology followed was described in Section 3.3, and detailed calculations are provided in Appendix F.7.

8.6.1 Data Evaluation

Several Chemicals of Concern (COCs) were identified at the Area A Weapons Center based on a comparison of site data to the risk-based COC screening levels described in Section 3.3.1. All data collected during the Phase I and II RIs, except data from soil samples collected from depths greater than 10 feet, were used to select COCs for soil, groundwater, sediment, and surface water. COC summary screening tables for all media are provided in Appendix F.7.

The COCs for soil at the site are as follows:

- PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene).
- Metals (antimony, arsenic, beryllium, chromium, and manganese).

Chromium was selected as a COC for "all soil" (soils from depths of 0 to 10 feet) only; the maximum detected concentration of this chemical in the surface soil samples was less than the COC screening level.

As summarized in the site-specific COC summary screening tables (in Appendix F.7), maximum detections in soil were also compared to USEPA Soil Screening Levels (SSLs) for migration to groundwater. Maximum detections for several chemicals (benzo(a)anthracene, carbazole, chrysene, barium, chromium, and nickel) in the site soil samples exceeded the SSLs, indicating the potential for these chemicals to migrate to groundwater and potentially impact water quality.

Several chemicals were detected at maximum concentrations exceeding the COC screening criteria for residential use of groundwater. These chemicals are:

- Halogenated aliphatic hydrocarbons (1,2-dichloroethane, 1,1,2-trichloroethane, and trichloroethene).
- PAHs (dibenz(a,h)anthracene and indeno(1,2,3-cd)pyrene).
- Metals (antimony, arsenic, beryllium, boron, chromium, lead, manganese, and thallium).

Antimony, which was not detected in the unfiltered groundwater samples, was retained as a COC because the maximum detection of this chemical in the filtered samples exceeded the associated risk-based COC screening level. Of the chemicals detected in this medium, only antimony, lead, and thallium were reported at maximum concentrations in excess of primary drinking water standards (i.e., MCLs and Action Levels).

COCs for surface water include arsenic and cadmium. Arsenic was the only chemical detected at a concentration exceeding AWQC. The same chemicals identified as COCs for soil at the site were selected as COCs for sediment. Two additional metals, cadmium and vanadium, were also selected for sediment.

Several organic chemicals (2-hexanone, 2-methylnaphthalene, acenaphthylene, benzo(g,h,i)perylene, phenanthrene, endosulfan sulfate, and endrin aldehyde) and some inorganic essential human nutrients (calcium, magnesium, potassium, and sodium) detected in the site media were not identified as COCs because no toxicity criteria are available to quantitatively evaluate these chemicals. In addition, USEPA Region I does not advocate a quantitative evaluation of exposure to aluminum and iron because the only available toxicity criteria for these chemicals are provisional reference doses based on allowable daily intakes rather than adverse effect levels. Exposure to these compounds is addressed in the uncertainty section of the baseline risk assessment, Section 3.3.5.

Because a limited number of samples were collected for soil and surface water, average (CTE) and maximum (RME) detected concentrations were used as exposure concentrations for these media as well as for groundwater, respectively. UCL determinations were made for sediment COCs at the Area A Weapons Center. However, average and maximum concentrations serve as the exposure concentrations for several sediment COCs because the distribution of the data set for several chemicals was considered to be undefined. The COCs and exposure concentrations for each media are presented in Table 8-15.

8.6.2 Exposure Assessment

Two receptor groups were considered likely to be exposed to media at the Area A Weapons Center: full-time employees and construction workers. The full-time employee could conceivably come into contact with surface soil on a routine basis (i.e., 150 days/year for 25 years under the RME and 6 years under the CTE). The construction worker is defined as having a one-time exposure while involved in a 1-year construction project. The RME construction worker could be exposed to groundwater (dermally) and soil for a period of 120 days, while the CTE worker is assumed to be exposed for 80 days.

Since the site is located in an area which could be potentially developed for residential land use if the naval facility were to close, a future residential exposure scenario was also evaluated at the direction of the USEPA. Future residents could come into direct contact with "all soil" (soil from depths of 0 to 10 feet), in addition to groundwater, which is assumed to be used for domestic purposes. Exposure to groundwater is assumed to occur on a daily basis (i.e., 234 days/year for the CTE and 350 days/year for the RME, while exposure to soil is expected to occur 150 days/year. The rationale for the selected exposure parameters was described in Section 3.3.3 for all identified receptor groups.

Inhalation of fugitive dust and volatile emissions from soil is evaluated qualitatively by a comparison of maximum soil concentrations to USEPA SSLs for the inhalation pathway. This comparison is provided in the site-specific COC summary screening tables, located in Appendix F.7. Maximum concentrations for all

chemicals detected in the soil were below the inhalation SSLs, which indicates the relative insignificance of this exposure route and eliminates the need for further quantitative evaluation of this exposure pathway at the Area A Weapons Center.

Dermal contact with soil was not evaluated quantitatively for the Area A Weapons Center since cadmium, dioxins, and PCBs were not detected in the site soil samples. Section 3.3.3 provided a qualitative discussion of exposure to other chemicals detected in the soil at NSB-NLON.

In addition, exposures to sediment and surface water at the site were not evaluated in a quantitative fashion as these exposures are presumed to be of lesser magnitude than direct contact with soil and groundwater. Full-time employees, construction workers, and future residents would likely come into contact with soil and groundwater at a greater frequency and duration than exposure to sediment and surface water. Since similar COCs and exposure concentrations are associated with soil and sediment and groundwater and surface water (as seen in Table 8-15), exposure to site media is considered to be adequately addressed by the quantitative evaluation of direct contact with soil and groundwater.

8.6.3 Risk Characterization

This section summarizes the quantitative risk assessment for the Area A Weapons Center. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor, are presented in Table 8-16 for the RME and CTE. Sample calculations are provided in Appendix F.3. Chemical-specific risks for the site are contained in Appendix F.7.

8.6.3.1 Noncarcinogenic Risks

No toxic effects are anticipated for the full-time employee because cumulative Hazard Indices (HIs) for this receptor were less than unity for both CTE and RME scenarios. In addition, the cumulative HI for the construction worker is less than unity for the CTE. Toxic effects may occur for the construction worker under the RME and future resident under CTE and RME conditions. Cumulative HIs for these receptors exceeded unity. Elevated noncarcinogenic risks for the construction worker and future resident are primarily attributed to manganese in groundwater. Dermal contact with groundwater is the primary exposure route of concern for both receptors, and ingestion of groundwater is an additional concern for the future resident. Elevated noncarcinogenic risks for the future resident are also associated with exposure to arsenic and thallium under the RME. All HQs for manganese for both receptors and arsenic and thallium for the RME future resident exceed unity for the aforementioned routes of exposure (Appendix F.7).

8.6.3.2 Carcinogenic Risks

Cumulative incremental cancer risks were less than or slightly above $1\text{E-}6$ for the full-time employee and the construction worker under both exposure scenarios. The cumulative incremental cancer risk for the CTE future resident ($6.6\text{E-}5$) was also within the USEPA's target risk range. However, for the RME future resident, the cumulative incremental cancer risk ($6.7\text{E-}4$) exceeded $1\text{E-}4$, the upper limit of the USEPA's target risk range. Estimated carcinogenic risks for future residents are mainly a result of exposure to dibenz(a,h)anthracene and arsenic in groundwater. Maximum detected concentrations of these chemicals were used to assess RME risks. The exposure route which contributes the most to the elevated carcinogenic risks for the RME is incidental ingestion of groundwater.

8.6.3.3 Exposure to Lead

Lead was identified as a potential COC for groundwater at the Area A Weapons Center. The maximum detected concentration of this chemical in a single site groundwater sample ($16.8\text{ }\mu\text{g/L}$) slightly exceeded the Federal Action Level of $15\text{ }\mu\text{g/L}$. Exposure to lead was addressed using the USEPA IEUBK Model, as discussed in Section 3.3.3; support documentation for the site-specific analysis is provided in Appendix F.7. Exposure concentrations for groundwater, which were presented in Table 8-14, were used, as well as site-specific soil concentrations and default values (for air, material contribution, etc.), to estimate blood lead levels for children in a residential setting. Estimated geometric mean blood lead levels for exposure to lead in the site media are $1.7\text{ }\mu\text{g/dL}$ for the CTE and $2.7\text{ }\mu\text{g/dL}$ for the RME. No adverse effects are anticipated for a child in a residential setting under both exposure scenarios since these values are less than the established level of "concern," $10\text{ }\mu\text{g/dL}$.

8.6.3.4 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, were provided in Section 3.5.5. Site-specific uncertainties for the Area A Weapons Center risk evaluation are presented below.

Some inorganic chemicals detected in site soils samples may be attributable to naturally occurring background levels. Background levels for metals in soil at NSB-NLON, developed by Atlantic Environmental Services, Inc., were presented in Table 1-2. Reported concentrations of aluminum, arsenic, beryllium, chromium, copper, iron, lead, and vanadium in the site surface soils were below the established NSB-NLON background levels.

For the construction worker, calculated risks associated with dermal contact with groundwater are slightly overestimated since this receptor was assumed to come in contact with groundwater collected from shallow and deep monitoring wells. Several organic compounds (1,2-dichloroethane, 1,1,2-trichloroethane, and trichloroethene) were selected as COCs for groundwater but were detected in the deep well 2WMW4D only. However, the ramifications of the employed approach for groundwater are not considered to be significant as elevated risks for the construction worker are primarily a result of exposure to metals, which were detected at similar concentrations in all groundwater samples.

8.7 ECOLOGICAL RISK ASSESSMENT

This section contains a site-specific ecological risk assessment for the Area A Weapons Center. Both maximum and average exposure point concentrations were considered in determining potential risks to ecological receptors. The process followed to determine exposure point concentrations and the methodology used to characterize risks to ecological receptors is summarized in Section 3.4. Detailed calculations are provided in Appendix I.4.

8.7.1 Conceptual Site Model

Surface water, sediment, and surface soil (0 to 2 feet) samples were collected from the Area A Weapons Center. Several pathways have been identified for exposure to chemicals associated with this site. One group of receptors (aquatic receptors) is most likely to be exposed to sediment and surface water through direct contact with or ingestion of sediment or surface water. A second group of receptors associated primarily with terrestrial habitat (e.g. red-tailed hawk, short-tailed shrew, soil invertebrates) is most likely to be exposed to site media via direct contact with the surface soil as a result of foraging, movement through the area, or burrowing in the soil (e.g., soil invertebrates). Additionally, terrestrial receptors could be potentially exposed through ingestion of surface water at the Area A Weapons Center.

8.7.2 Exposure Assessment

The Area A Weapons Center is well-developed and is characterized by buildings, paved areas and maintained lawns (Section 8.3.6). However, it is surrounded by upland coniferous/deciduous forest, a small area characterized as upland deciduous forest/shrub, and the Area A Wetland. These areas are likely to support ecological receptors that may encounter chemicals associated with the Area A Weapons Center as they move through the site to nearby locations. Additionally, this site contains surface drainage ditches which may be used as a source of drinking water. Although they do not currently support an aquatic community, for the purposes of this risk assessment, it was conservatively assumed that these ditches were inhabited

by aquatic organisms. Aquatic biota inhabiting the Area A Weapons Center drainage ditches may be exposed to chemicals through direct contact with and ingestion of surface water and sediment and, indirectly, through the ingestion of prey. Complete exposure pathways for this site also include potential uptake of chemicals by terrestrial vegetation and exposure of soil invertebrates by direct contact with chemicals present in soil moisture or through soil ingestion. Complete exposure pathways for small mammals include direct contact with soil, incidental ingestion of soil while foraging, ingestion of surface water, and consumption of prey. Predators could be exposed to chemicals at this site by consumption of prey, ingestion of surface water, or incidental ingestion of soil.

8.7.3 Receptor Organisms

As noted above, the habitat currently associated with the Area A Weapons Center is unlikely to support populations of wildlife receptors. However, for the purposes of this ecological risk assessment, it was assumed that the drainage ditches at the Area A Weapons Center supported a population benthic invertebrates and aquatic receptors. The rest of the site was assumed to support a population of soil invertebrates that were preyed upon by short-tailed shrews that both inhabited and foraged in the area. These insectivores served as prey for red-tailed hawks. The same conservative assumptions summarized in Section 3.4.4.2 were retained for this assessment.

8.7.4 Chemicals of Concern

As discussed in Section 8.7.1, surface soils, sediment, and surface water all are media with which ecological receptors are likely to come in contact. COCs were selected by comparing exposure point concentrations (both maximum and average values; Appendix I.4) detected in surface soil, sediment, and surface water samples to the following (see also Section 3.4.2):

- Inorganics were compared to concentrations of inorganic constituents present in samples collected from NSB-NLON background locations.
- Inorganics present in concentrations greater than NSB-NLON background concentrations and all organic compounds were compared to conservative benchmark values protective of benthic invertebrates, terrestrial vegetation, soil invertebrates, the short-tailed shrew, and the red-tailed hawk. In addition, all contaminants whose concentrations exceeded chronic benchmark values were compared to acute benchmark values.

COCs identified as a result of comparing both the maximum and average concentrations of chemicals detected in sediment, surface water, and surface soils collected from this area to benchmark values are summarized in Table 8-17.

8.7.5 Risk Characterization

The ecological risk characterization for Site 20 Area A Weapons Center is summarized in this section. Risks to aquatic biota terrestrial vegetation, soil invertebrates, and terrestrial vertebrates are evaluated. Detailed media and receptor-specific calculations used to determine ecological risks for the site are contained in Appendix I.4.

8.7.5.1 Aquatic Biota

As discussed in Section 3.4.2.3, potential risks to aquatic biota were determined by comparing the maximum and average surface water and sediment concentrations to benchmarks protective of these organisms. The resulting HQs are summarized in Appendix I.4 and Tables 8-18 and 8-19.

When the maximum concentrations in surface water were compared to benchmarks protective of aquatic receptors, it was determined that cadmium, iron, lead, and zinc exceeded both their background concentrations and their respective benchmark values (Table 8 - 18). These results indicate that, based on exposure to maximum concentrations of inorganics in surface water, aquatic receptors inhabiting the Area A Weapons Center are potentially at risk. Comparison of the average concentrations of inorganics to benchmark values protective of aquatic biota also indicated that cadmium, lead, and zinc (HQs = $1.4E+1$, $1.7E+1$ and $6.0E+0$, respectively; Table 8-19) were present in concentrations that represented a potential risk to these receptors. None of the organic contaminants detected in surface water samples collected from Area A Weapon Center were present in concentrations that represent a risk to aquatic biota (Appendix I.4). These results suggest that inorganic chemicals associated with surface water collected from the Area A Weapons Center may potentially have an adverse impact on aquatic biota.

For acute comparisons for inorganics, only the maximum concentrations of cadmium, iron, and zinc exceeded benchmark values (Appendix I.4). For average comparisons to acute benchmarks, cadmium and zinc had HQs > 1.

When the maximum sediment concentrations were examined, it was determined that cadmium, selenium, manganese, lead, copper, zinc, mercury, chromium, arsenic, and nickel exceeded NSB-NLON background concentrations and their respective benchmark values (Table 8-17). With the exception of arsenic, selenium,

chromium, and mercury, the highest concentration of each of these metals was detected in samples 2WCSD5, collected from a drainage ditch in drainage area 3. However, the HQs calculated for these inorganics were less than those calculated for gamma chlordane ($HQ = 3.6E+2$). The pesticides endrin aldehyde ($HQ = 2.3E+1$), 4,4'-DDE ($HQ = 1.6E+10$) and 4,4'-DDT ($HQ = 6.0E+0$; Table 8-20) also represented a potential risk to aquatic biota. The maximum concentrations of gamma-chlordane, endrin aldehyde, methoxychlor, endosulfan sulfate, and endrin were also detected in the samples collected from 2WCSD5 (Table 8-12). These results indicate that benthic organisms exposed to the maximum concentrations of chemicals detected in sediment collected from Area A Weapons Center ditches are potentially at risk.

When the average concentrations of inorganics in the drainage ditch sediments were compared to their respective benchmark values, only selenium, cadmium, copper, chromium and mercury had HQs greater than 1.0 (Table 8-21). HQs calculated for a number of organics detected in these samples (e.g., gamma-chlordane, 4,4'-DDE, endrin aldehyde, methoxychlor, and endosulfan sulfate) were somewhat higher than those calculated for the average concentrations of the inorganics (Table 8-21). These results indicate that the average concentrations of both inorganics and organics represent a potential risk to benthic organisms inhabiting the Area A Weapons Center drainage ditches.

For comparison of maximum concentrations of inorganic COCs to acute sediment benchmarks, cadmium, manganese, and selenium exceeded benchmarks (Appendix I.4); only selenium was a COC for average comparisons. For organics, the maximum and average concentrations of endosulfan sulfate and methoxychlor resulted in their retention as acute sediment COCs.

8.7.5.2 Terrestrial Vegetation

As discussed in Section 3.4.2.3, potential risks to terrestrial vegetation were determined by comparing chemical concentrations to conservative, phytotoxic benchmarks. The benchmark values listed in Will and Suter (1994) are conservative and do not consider site-specific soil characteristics which may affect the bioavailability of chemicals (and their potential toxicity) to plants (Section 3.4.2.3). Maximum and average chemical concentrations detected in surface soil samples were compared to these phytotoxic benchmark values and HQs were determined. Chemicals associated with the Area A Weapons Center were considered to represent a risk to terrestrial vegetation if the HQs exceeded 1.0. The HQs determined for this site are summarized in Tables 8-22 (maximum concentrations) and 8-23 (mean concentrations).

When maximum concentrations of surface soil chemicals were compared to phytotoxic benchmark values, four inorganics with HQs greater than 1.0 were identified (Table 8-22). The maximum concentrations of

aluminum, chromium, and vanadium produced the highest HQs with respect to these receptors (HQs = $1.9E+2$, $1.2E+1$, and $9.0E+0$ respectively; Table 8-22). When the average concentrations in surface soil were compared to the phytotoxic benchmarks, HQs decreased somewhat (the HQ values for aluminum, chromium, and vanadium equalled $1.3E+2$, $9.8E+0$, and $7.4E+0$, respectively). However, with the exception of antimony, the same chemicals identified as representing a potential risk to vegetation when maximum concentrations were considered still had HQs greater than 1.0 when average concentrations were used (Table 8-23). Based on this conservative assessment, terrestrial vegetation associated with the Area A Weapons Center may be adversely impacted as a result of exposure to surface soil.

8.7.5.3 Terrestrial Fauna

Soil Invertebrates

Conservative benchmark values protective of earthworms were used to identify potential risks to soil invertebrates. The maximum and average concentrations of inorganics detected in surface soil samples collected from the Area A Weapons Center were compared to NSB-NLON background concentrations. Inorganics at concentrations greater than background values and all organics were then compared to benchmark values developed for earthworms (see Section 3.4.2.3) and HQs were determined (see Appendix I.4). Chemicals associated with the Area A Weapons Center were considered to represent a risk to terrestrial invertebrates if the HQs exceeded 1.0.

The maximum concentrations in surface soil were compared to benchmark values developed to be protective of soil invertebrates. The results of this comparison determined that no chemicals were present at concentrations that could adversely impact these receptors (Appendix I.4). As discussed in Section 3.4.2.3, data regarding the toxicity of soil chemicals to soil invertebrates is limited and difficult to interpret, but the results of this assessment suggest that soil invertebrates are not at risk from exposure to soil contaminants. However, it should be noted that the "main environmental concern about earthworms and higher soil metal concentrations is that the metals will accumulate to concentrations toxic to predators, rather than that the metals will be toxic to earthworms" (Beyer, 1990). This is particularly true of cadmium; these soil invertebrates are known to greatly concentrate cadmium relative to soil (Beyer, 1990). Therefore, although these results suggest that soil invertebrates not being adversely impacted by soil contaminants detected at this location, it is possible that predators feeding on these organisms may be exposed to soil contaminants concentrated in their tissue.

Terrestrial Vertebrates

Potential risks to terrestrial ecological receptors coming in contact with surface soil were assessed by examining risks to the short-tailed shrew and red-tailed hawk. Exposure pathways considered in this assessment for this site included the ingestion of prey, direct contact with the soil, incidental ingestion of soil, and ingestion of surface water. All calculations performed for representative animals potentially inhabiting the Area A Weapons Center are contained in Appendix I.4.

As discussed in Section 3.5.3, risks to terrestrial receptors are expressed in terms of HIs, which are the sum of chemical-specific HQs. Tables 8-24 and 8-25 contain the HIs calculated for each receptor exposed to the maximum and average surface water and surface soil concentrations.

The HI calculated for the short-tailed shrew using maximum surface soil and surface water concentrations ($HI = 1.4E+2$) indicates that this species was potentially at risk (Table 8-24). Three analytes (antimony, phenanthrene, and barium) contributed most significantly to this receptor's potential risk ($HQs = 9.7E+1$, $1.1E+1$, and $1.1E+1$, respectively). Ingestion of prey (44.6%) and incidental ingestion of soil (55.3%) contributed the majority of the risk (Table 8-24).

When average soil concentrations were used, somewhat lower risks ($HI = 1.3E+2$; Table 8-25) resulted. Antimony, barium, and phenanthrene were the contaminants that made the greatest contribution to the this receptor's potential risk ($HQ = 9.0E+1$, $1.1E+1$, and $3.4E+0$, respectively; Table 8-25).

Using acute toxicity benchmark values, no HIs > 1 were calculated for the short-tailed shrew for either the maximum or average exposure scenarios (Appendix I.4). This suggests insignificant potential acute risks to this receptor.

When the maximum soil and surface water concentrations were compared to conservative benchmark values developed for the red-tailed hawk, an HI of $4.4E+0$ was calculated (Table 8-24). Antimony ($HQ = 2.2E+0$) was the sole analyte present at a concentration that resulted in HQs greater than 1.0 (Table 8-24). Ingestion of food (33.4%) and incidental ingestion of soil (66.3%) represented the primary means of exposure to site-related chemicals.

Comparison of the average surface soil and surface water concentrations to the benchmark values developed for the red-tailed hawk resulted in a minor reduction in potential risk. Antimony ($HQ = 2.0E+0$) remained the only analyte with an HQ greater than 1.0 (Table 8-25). The HI dropped to $3.6E+0$. Ingestion of prey (29.7%) and incidental ingestion of soil (69.9%) represented the primary routes of exposure. These

results indicate that exposure to the average surface soil and surface water concentrations also represent a potential risk to these predators.

Using acute toxicity benchmarks for the red-tailed hawk, no HIs > 1 were generated for either the maximum or average exposure scenarios, suggest no acute potential risks to this avian receptor (Appendix I.4).

8.7.5.4 Uncertainties

As discussed in Section 3.4, the following conservative assumptions were maintained in performing this ecological risk assessment:

- the site use factor was assumed to equal 100% (i.e., the organisms were assumed to live and forage exclusively within the boundaries of this site),
- minimum body weights were used to calculate receptor dose
- maximum ingestion rates were used to calculate receptor dose
- contaminants were assumed to be 100% biologically available
- the most sensitive life stage was assumed to be exposed to site contaminants
- it was assumed that only contaminated prey were consumed.

By adopting these conservative assumptions, the final risk estimates are deliberately conservative and are likely to overestimate the actual risk associated with contaminants detected at the Area A Weapons Center. This approach was taken so it may be concluded with confidence that certain chemicals detected at this site are unlikely to represent an ecological risk. While this process serves to significantly reduce the uncertainty associated with eliminating certain chemicals from further consideration, uncertainty is associated with concluding that exposure to the remaining chemicals are adversely impacting ecological receptors. An analysis of the uncertainty associated with the risk assessment process is important in that it identifies, and, to the extent possible, quantifies the uncertainty associated the entire process (problem formulation, data analysis and risk characterization). The uncertainty introduced into the risk assessment process stems from three sources: 1) imperfect knowledge of things that should be known, 2) systematic errors (e.g., computational, data, or analytical transformation errors), and 3) nonsystematic errors (i.e., random or stochastic errors) and variability in the system being assessed (Solomon et. al, 1996). A detailed discussion of uncertainties associated with the assessment process is contained in Section 3.4. This section focuses on uncertainties and assumptions that should be considered when interpreting the results of the ecological risk assessment performed at the Area A Weapons Center.

As noted above, it was conservatively assumed that the site use factors for both the shrew and the red-tailed hawk equaled 100%. As discussed in Section 8.3.6, the Area A Weapons Center is relatively well-developed and much of the area is paved. These factors reduce the possibility that ecological receptors will come into contact with soil contaminants. The assumption that the Area A Weapons Center supports ecological receptors with ready access to site contaminants results in an overestimation of risk. In addition the lack of desirable habitat, the areal extent of the Area A Weapons Center is much smaller than that of the red-tailed hawk. The area encompassed by the site (approximately 2.5 ha) is 4.2% of the red-tailed hawk's home range (home range = 60 ha - 160; Table 3-27). Therefore, even if this site served as a potential source of prey, it is too small to support this receptor. When the size of the Area A Weapons Center is factored into the HI calculations for this species, the resulting values are less than 1.0. These results, coupled with the fact that this site provides little habitat, suggests that contaminants detected in this location are unlikely to represent an actual risk to this receptor.

The shrew's home range (0.1 - 0.22 ha) is much smaller than that of the red-tailed hawk and could be encompassed within the boundaries of the Area A Weapons Center. Therefore, aside from the limited nature of the habitat, the assumption that the shrew could forage exclusively in this area is appropriate. However, as indicated above, it was also assumed that this receptor exclusively consumed contaminated prey. It is much more likely that the shrew would feed on contaminated and uncontaminated prey, which would reduce its exposure to site contaminants. This assumption therefore results in an overestimation of risk.

Uncertainty is also associated with characterizing the toxicity of contaminants detected at this site. The ecological risk assessment determined that a number of inorganic contaminants present in surface water samples collected from the Area A Weapons Center produced HQ values in excess of unity for aquatic biota. The benchmark values used to characterize risks to aquatic biota (e.g., chronic ambient water quality criteria) were deliberately conservative and tend to overestimate risks. For instance, ambient water quality criteria are based on total contaminant concentrations (measurement includes bound and dissolved contaminants) rather than dissolved (i.e., more biologically available) contaminant concentrations. Furthermore, the ambient water quality criteria for metals and other contaminants are primarily based on the results of laboratory toxicity tests. Metals used in these tests are typically in the form of simple salts that are added to relatively clean (e.g., laboratory grade) water. Contaminants in these laboratory toxicity tests are generally more bioavailable than contaminants present in ambient water that typically contains significant concentrations of binding agents. These laboratory test conditions contribute to the conservative nature of ambient water quality criteria.

Conservative benchmark values were also used to assess risks to benthic macroinvertebrates exposed to contaminated sediments. Contaminants resulting in the highest HQ values included gamma chlordane,

endrin aldehyde, DDTR, and several other pesticides. The methods used to characterize ecological risks for benthic organisms were those reviewed and approved by USEPA's Science Advisory Board for establishing sediment quality criteria for nonpolar organic chemicals (Equilibrium Partitioning; USEPA, 1993). This method depends on the sediment organic content, chronic ambient water quality criteria, and K_{oc} s. K_{oc} s were calculated from K_{ow} s for these organic contaminants using the regression equation listed in Section 3.4. Therefore, the reliability of the site-specific benchmark value for an organic contaminant depends directly on the reliability of the K_{ow} s for these contaminants. Measured K_{ow} s for most organic chemicals reported in the literature are highly variable - a range of two orders of magnitude is not unusual (USEPA, 1993). Investigations by USEPA have determined that newer methodologies for measuring K_{ow} (i.e., the generator column and the slow stirring methods) appear to produce reproducible, accurate results, whereas values generated using older methods of measurement were highly variable. The K_{ow} s used to calculate the site-specific sediment benchmark values were those reported in Table 3-2 of this report and compiled by USEPA in Appendix IX to 40 CFR Part 264, September, 1992. Uncertainty associated with these values would be reduced if it could be determined whether or not the generator column or slow stirring methods were used to generate the K_{ow} s used in these calculations. Alternatively, K_{ow} values generated by the USEPA Research Laboratory in Athens, GA and summarized in an unpublished USEPA internal report (USEPA, 1995b) might be used to perform these calculations and reduce the uncertainty associated with these calculations.

In addition to the K_{ow} , the site-specific organic sediment benchmark values also depend on the reliability of the ambient water quality criterion. The Federal and State of Connecticut chronic ambient water quality criteria (CAWQC) for DDTR are the same ($0.001 \mu\text{g/L}$) and were generated using aquatic toxicity data available in 1980 (USEPA, 1980). This CAWQC was used in the calculations performed to predict site-specific benchmark values protective of benthic organisms. This values is protective not of aquatic biota but of sensitive vertebrate (i.e., the brown pelican) receptors. It is possible that this value may be too conservative for aquatic biota, resulting in an overestimation of the actual risks to these receptors.

Finally, it should be noted that the Equilibrium Partitioning Method (EqP) is based on the assumption that the amount of sediment organic carbon and the bulk sediment organic contaminant concentrations are related. However, EqP assumptions are only approximately true; therefore, predictions based the model are inherently uncertain. This uncertainty reflects the inherent variability in the experimental results used to test the model and the fact that various phenomena have not been accounted for by the model (USEPA, 1993).

While inorganic contaminants were present in excess of conservative sediment benchmark values, no additional data were available to assess the biological availability of these contaminants (i.e., acid volatile

sulfide concentrations were not measured). Without these data, it is not possible to determine whether inorganics, rather than organic contaminants, represent a greater potential risk to benthic macroinvertebrates. Regardless of the uncertainties associated with the benchmark values used to assess the potential risks to aquatic biota, it should be borne in mind that the Area A Weapons Center waterbodies are actually ditches that are typically dry and do not support aquatic biota. The assumptions used in this assessment therefore result in an overestimation of risk to these organisms.

Uncertainty is also associated with the biological availability of soil organic contaminants. None of the samples collected from this site were analyzed for TOC. In the absence of site-specific data, the lowest concentration of TOC measured in samples collected from the Area A Downstream Watercourses and OBDA (TOC = 13,000 mg/kg) was used to predict BAFs for organic contaminants present in surface soil. It is not known if this value over or under represents actual TOC concentrations at the Area A Weapons Center or how well the predicted earthworm BAFs for soil organics represent actual BAFs.

It was determined that aluminum contributed most significantly to the potential risks calculated for terrestrial vegetation. According to Will and Suter (1994), aluminum exerts a toxic response in terrestrial vegetation by interfering with cellular division in roots, decreasing root respiration, binds with phosphorus so that it is not biologically available, interferes with the uptake of essential nutrients (calcium, magnesium, phosphorus) and water, and disrupts enzyme activity. Seedlings are more susceptible to the effects of aluminum toxicity than are older plants (Will and Suter, 1994).

The aluminum benchmark value used to determine if this metal represented a potential risk to terrestrial vegetation was taken from Will and Suter (1994). The benchmark is based on the results of a single study that documented a 30% reduction in white clover seedling establishment when 50 mg/kg aluminum was added to a sandy loam soil with a pH of 5.0. Because only a single study describing the phytotoxicity of aluminum could be identified, the confidence in this benchmark, and therefore the conclusions regarding the potential impacts of aluminum on vegetation within the Area A Weapons Center, is limited.

It was determined that antimony contributed most significantly to the HIs calculated for both the shrew and red-tailed hawk (Tables 8-24 and 8-25). Antimony is commonly employed in the manufacturing of alloys, armaments (e.g., bullets), fireworks, coating metals, etc. (Merck Index, 1989). As summarized in Appendix H, environmental leaching is low and antimony does not appear to concentrate in fish or other aquatic organisms. The use of a bioaccumulation factor of 1.0 to account for the uptake of antimony from soil by earthworms therefore contributes to the conservative nature of this risk assessment. Studies conducted on moles, shrews, and rabbits collected from near a smelter also indicate that although the amount of antimony

measured in various organs was elevated, it was low compared to the amount of antimony ingested. These results indicate that antimony does not appear to biomagnify in food chains (ATSDR 1992).

Antimony is regarded as a nonessential metal and is easily taken up by plants if present in soluble forms (Kabata-Pendias and Pendias, 1992). Other than a general, qualitative description of the appearance of plants grown in antimony-contaminated soil, no other information exists on the phytotoxic effects of this metal. In animals, antimony is similar to arsenic in its general effects and in its affinity for sulfhydryl groups in enzymes. By binding to sulfhydryl groups, antimony and arsenic disrupt oxidative phosphorylation, consequently producing widespread impacts. Target organs include the cardiovascular system, the gastrointestinal tract, the kidneys, skin, nervous system, and liver (Ellenhorn and Barceloux, 1988).

As summarized in Table 3-17, the endpoint (NOAEL) used to assess risks to terrestrial vertebrates associated with exposure to antimony were based on a study summarized in Opresko et. al (1994). This study reported the results of a laboratory toxicity test conducted on female mice exposed to a single concentration of antimony (5 mg/kg antimony potassium tartrate) administered orally in drinking water. This form of antimony has been used as a mordant in the textile or leather industry or as a veterinary therapeutic agent for the treatment of parasites (Merck Index, 1989). Because the form of antimony detected in samples collected from the Area A Weapons Center is not known, the degree to which the benchmark based on these test results accurately reflects antimony's toxicity can not be determined.

The study performed on female mice extended for more than a year. The results of the test therefore represent the effects of long term chronic exposure and are consistent with the assumption that exposure to site contaminants is also probably chronic. Chronic exposure to antimony resulted in a decrease in the median lifespan of female mice. Because only one concentration tested in the study, the resulting LOAEL values were converted to NOAEL values by multiplying by 0.1. No studies concerning the toxicity of antimony to bird species could be located. Therefore, to evaluate the potential risks of this contaminant to avian receptors, conversion factors were applied to the mammalian test results. The use of conversion factors to extrapolate from LOAELs to NOAELs and from mammalian to avian toxicity endpoints contributes to the uncertainty associated with the results of this risk assessment.

8.8 COMPARISON OF SITE DATA TO CONNECTICUT STANDARDS

Analytical data for the Area A Weapons Center were compared to Connecticut drinking water standards, remediation standards (CTDEP, January 1996), and Water Quality Standards (1992). Tables summarizing the comparison of site data to Connecticut standards are provided in Appendix F.7. These tables, which follow the quantitative risk assessment spreadsheets in the cited appendix, identify, on a media-specific

basis, those chemicals detected at concentrations in excess of state criteria. Maximum and average chemical concentrations are presented in the summary tables. Although the maximum concentration of a chemical may exceed an associated state criteria, the distribution of the chemical in the medium is also important with respect to decision making. Therefore, the average chemical concentration was included to provide some information on the potential distribution of the chemical. A brief narrative of the findings of this qualitative analysis is provided in the remainder of this section.

Site-specific soil data were compared to Connecticut remediation standards for direct exposure and pollutant mobility. Direct exposure criteria for residential exposure were used to conservatively evaluate potential exposure to soil at the site. The following chemicals were found at maximum concentrations exceeding the state remediation standard for direct exposure under residential land use:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Arsenic

To address concerns regarding migration of chemicals from soil to groundwater, site soil data were compared to Connecticut remediation standards for pollutant mobility. The groundwater classification for the Area A Weapons Center is GB, which indicates that although the State recognizes that groundwater may not meet GA criteria at this time, the goal is to restore groundwater to GA quality. The list of chemicals reported at maximum concentrations exceeding the GB pollutant mobility criteria consists of:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene

A qualitative evaluation of the TCLP analytical results for the site soil samples (in relation to state pollutant mobility criteria for inorganics and PCBs) is provided in Table 8-4. No exceedances of GB pollutant mobility criteria were observed for these chemicals.

Analytical groundwater data for the site were compared to Connecticut MCLs and remediation standards for groundwater and surface water protection. Thallium was the only chemical detected in the unfiltered groundwater samples at a maximum concentration exceeding the state MCL. Antimony was detected at a concentration in excess of the state MCL in unfiltered groundwater samples. Manganese was detected in the unfiltered and filtered groundwater samples at maximum concentrations exceeding the 5 mg/L

Connecticut Department of Public Health and Addition Services Action Level. Maximum concentrations of sodium in the unfiltered and filtered groundwater samples also exceeded the State Notification Level of 28 mg/L.

Maximum groundwater concentrations (unfiltered and/or filtered) for the following chemicals exceeded the Connecticut remediation standards for groundwater protection:

- Bis(2-ethylhexyl)phthalate
- Antimony
- Lead
- Thallium

It should be noted that the groundwater protection criteria are applicable for GA or GAA designated groundwater and are also used to protect existing groundwater regardless of the classification.

Since groundwater at the Area A Weapons Center eventually discharges to a surface water body (i.e., Area A Wetland), site-specific groundwater data were also compared to Connecticut remediation standards for surface water protection. Those chemicals found at maxima exceeding the surface water protection criteria are, as follows:

- Arsenic
- Lead

For surface water, a qualitative analysis of risk associated with the site data was conducted using Connecticut Water Quality Standards for and human health, which are similar to Federal AWQC. The only chemical reported at a maximum exceeding the state AWQC for the consumption of organisms and/or water and organisms was arsenic.

Sediment samples were also collected at the site. No state criteria are available to address potential exposure to this medium. Site-specific sediment data were compared to Connecticut remediation standards for soil (i.e., for direct exposure and pollutant mobility) to provide some qualitative indication of the risks associated with sediment from the state's perspective. Maximum detections of the following chemicals were in excess of direct exposure criteria for residential land use:

- Benzo(a)anthracene
- Benzo(a)pyrene

- Benzo(b)fluoranthene
- Arsenic

It should be noted that, in general, direct exposure to sediment is expected to occur on a less frequent basis than exposure to soil. Consequently, the qualitative analysis for this medium is regarded as conservative.

Sediment chemicals reported at concentrations exceeding the soil pollutant mobility criteria for a GB designated area are, as follows:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene

8.9 SUMMARY AND CONCLUSIONS

This section presents a summary of major findings of the Phase II RI for the Area A Weapons Center. A summary of the nature and extent of contamination is provided in Section 8.9.1. Sections 8.9.2 and 8.9.3 summarize the baseline human health risk assessment and ecological risk assessment for the site respectively. Section 8.9.4 summarizes the comparison of site data to state standards and Section 8.9.5 provides recommendations regarding additional action or investigatory efforts for the site.

8.9.1 Nature and Extent of Contamination

Organic and inorganic chemicals were detected in the various media samples at the Area A Weapons Center. The most prevalent chemicals detected included phthalate esters and PAHs. Volatile organic chemicals were also detected, but the concentrations were typically quite low. The highest detection of a volatile organic chemical in soil was 690 $\mu\text{g}/\text{kg}$ (acetone), with most other volatile organic concentrations being much lower. By contrast, PAHs were detected at concentrations ranging as high as 5,700 $\mu\text{g}/\text{kg}$ in the soil matrix.

Analytical results for groundwater samples indicate that little impact on groundwater has occurred as a result of surficial contamination at the site. Few organic chemicals were detected in groundwater, and all concentrations were 12 $\mu\text{g}/\text{L}$ or less. However, a few metals (most notably manganese at a maximum concentration of 6,540 $\mu\text{g}/\text{L}$) were detected at elevated concentrations in the groundwater samples.

Similarly, surface water results indicate that little impact on surface water quality has occurred. The only organic chemicals detected in surface water were di-n-octylphthalate and butylbenzylphthalate (both 2 $\mu\text{g/L}$ or less).

Sediment analytical results are consistent with those for the soil samples; PAHs were detected in sediment samples from the three drainage areas at concentrations ranging as high as 6,900 $\mu\text{g/kg}$ (fluoranthene and pyrene). Other organics detected in sediment samples included pesticides (e.g., endrin aldehyde at 140 $\mu\text{g/kg}$), trichloroethene (22 $\mu\text{g/kg}$), and methylene chloride (22 $\mu\text{g/kg}$). The most pervasive and concentrated chemicals detected in solid matrices at the site were PAHs, which are ubiquitous chemicals often associated with the use of asphalt paving materials or automobile or stack emissions. Numerous metals were also detected in sediment samples, with elevated concentrations of a few metals (most notably cadmium, lead and manganese).

Overall, the analytical data indicate that minimal contamination other than that which is often found in urban and industrial areas exists at the site. Furthermore, the data for surface water and groundwater samples indicate that the site is not acting as a source of contamination for downstream or downgradient locations.

8.9.2 Baseline Human Health Risk Assessment

Three potential receptor groups were considered for the Area A Weapons Center based on current and projected future land use. These include full-time employees, construction workers, and potential future residents. Both noncarcinogenic and carcinogenic risk estimates were generated for these receptor groups.

Noncarcinogenic risk estimates for the full-time employee and the construction worker for the CTE were less than one. Noncarcinogenic risks for the RME construction worker and potential future residents (CTE and RME) exceed the USEPA acceptable level of one. Future residents are assumed to use groundwater as a potable water supply, whereas construction workers are exposed to groundwater via dermal contact only. The majority of the noncarcinogenic risks are associated with exposure to manganese in groundwater, which is a commonly found naturally occurring metal. Arsenic and thallium are additional noncarcinogens of concern for the future resident exposed to groundwater. Incremental lifetime cancer risks except for the RME future resident, were less than $1\text{E-}6$ or within the USEPA's acceptable target risk range of $1\text{E-}4$ to $1\text{E-}6$. Carcinogenic risks for future residents are primarily attributable to the presence of dibenz(a,h)anthracene and arsenic.

8.9.3 Ecological Risk Assessment

As described in Section 8.7, the Area A Weapons Center currently represents an undesirable wildlife habitat; the site is well-developed and characterized by buildings, weapons storage bunkers, paved areas between the bunkers and maintained lawns. Drainage ditches in this area typically do not contain standing water for any extended period of time and currently do not support an aquatic community. However, the Area A Weapons Center does border areas that do represent a potential wildlife habitat. Using the conservative assumptions discussed in Section 3.4.4.2, both the maximum and average concentrations of contaminants detected in surface water, sediment, and surface soils collected from this site exceeded benchmark values protective of various aquatic and terrestrial ecological receptors. The results of these comparisons indicate that chemicals associated with this site could adversely impact aquatic biota, terrestrial vegetation, and terrestrial vertebrates if present. However, none of the chemicals detected at this site represent a risk to soil invertebrates.

However, it should be noted that the primary concern with respect to soil invertebrates and heavy metal contaminants is not the direct impact of these contaminants, but the fact that soil invertebrates, particularly earthworms, can tolerate these contaminants in their tissues. This is particularly true of cadmium; these soil invertebrates are known to greatly concentrate cadmium relative to soil (Beyer, 1990). Therefore, although these results suggest that soil invertebrates are not being adversely impacted by soil contaminants detected at this location, it is possible that predators feeding on these organisms may be exposed to soil contaminants concentrated in their tissue.

The results of the ecological risk assessment indicate that with the exception of soil invertebrates, organisms using this area would potentially be at risk, assuming that the Area A Weapons Center provided habitat and forage for terrestrial receptors. However, because of the current conditions associated with this site, actual risks to ecological receptors are likely to be much less than those calculated for this area. For instance, the results of this conservative assessment indicated that terrestrial vegetation would be adversely impacted. However, the site does support a well-established lawn. Areas bordering the Area A Weapons Center (e.g., the nearby upland coniferous/deciduous forest) do represent a desirable habitat for wildlife. Organisms inhabiting this area may come in contact with surface water, sediment, or soil while moving through the area to forage in the nearby Area A Wetland or upland areas. While potentially exposed to soil contaminants, this exposure is much more limited than that considered in this evaluation (see Section 3.4.4.2 for exposure assumptions), thereby reducing the actual ecological risks associated with this site. When the current site conditions are factored into this evaluation, it is concluded that the Area A Weapons Center represents little potential risk to ecological receptors that might utilize this area. However, it should be noted that, due to

potential transport from this site, contaminants associated with the Area A Weapons Center may be impacting organisms inhabiting the Area A Wetland.

8.9.4 Comparison of Site Data to State Standards

Various chemicals were detected in the site media at maxima exceeding the state standards discussed in Section 8.8. All soil chemicals reported at maxima in excess of Connecticut remediation standards for pollutant mobility were identified as COCs in the baseline human health risk assessment.

For groundwater, almost all of the chemicals found at concentrations exceeding state standards were retained as COCs in the baseline human health risk assessment, except for bis(2-ethylhexyl)phthalate and sodium. No dose-response parameters are available for sodium, and it should be noted that the applicable state standard for this chemical is a Notification Level for a drinking water source. Although the maximum detection of bis(2-ethylhexyl)phthalate exceeded the groundwater protection criteria, the maximum concentration of this chemical was less than the risk-based COC screening level.

Surface water and sediment data were also compared to state standards. With respect to state AWQC for human health, only arsenic was found at a maximum exceeding the applicable criteria. This chemical was identified as a COC for surface water in the human health risk assessment. For sediment, benzo(k)fluoranthene was reported at a maxima exceeding the pollutant mobility criteria, but was not retained as a COC in the human health risk assessment. Although the maximum of this chemical was less than the risk-based COC screening criteria for soil ingestion, this chemical may migrate to groundwater and potentially impact water quality.

8.9.5 Recommendations

It is recommended that this site proceed to a Feasibility Study (FS) to evaluate a "limited action" effort consisting of a groundwater monitoring program and possibly access/use restrictions. This recommendation for the Area A Weapons Center is based on the following supporting information:

- The potential exists for contaminants to migrate from the site to the Area A Wetland and impact ecological receptors. Although notable levels of contamination have been detected in soils and sediment at the site, the most prevalent contaminants detected included phthalate esters and PAHs, which are relatively less soluble compounds, and are therefore, less mobile. Volatile organic chemicals were detected at low concentrations, with the maximum detected volatile organic concentration in soil of 690 $\mu\text{g/kg}$ (acetone in one sample). Elevated concentrations

of PAHs were detected in one of the Area A Wetland sediment samples (2WSD9) which was located in a drainage ditch exiting the Area A Weapons Center. Although this suggests that the Weapons Center is a contaminant source, it is believed that the contamination is limited in extent. This is supported by the fact that Weapons Center sediment sample 2WCSD11, which is located immediately adjacent to 2WSD9, only exhibited marginal concentrations of PAHs.

- Analytical results indicate minimal contamination of surface water and groundwater. The only organic compounds detected in surface water were di-n-octylphthalate and butylbenzylphthalate (both at concentrations of 2 $\mu\text{g/L}$ or less). Few organic compounds were detected in groundwater samples at the site, and all concentrations were less than 12 $\mu\text{g/L}$. Manganese has been detected in groundwater at elevated concentrations at the site, however this finding is consistent with the frequent detection of this chemical element at numerous other sites at the facility, and in the proximate Thames River.
- Low human health risks are associated with the site, based on the current land use scenario. The noncarcinogenic risk estimates were all below the USEPA acceptable level of one for the full-time employee and the construction worker under the CTE and above one for the construction worker under the RME and potential future resident. The calculated incremental lifetime cancer risks were all less than $1\text{E-}6$ or within the USEPA acceptable target risk range of $1\text{E-}4$ to $1\text{E-}6$, for all scenarios except the RME future resident. The elevated risks to the construction worker and future resident are primarily attributable to exposure to groundwater beneath the site. It is unlikely that the future residential and construction worker scenarios that were evaluated would occur under future land use. It is required (per OSHA standards for work on hazardous waste sites) that health and safety measures (i.e., personal protective equipment and monitoring) be instituted to minimize direct soil and groundwater contact during future construction. Therefore, following these health and safety measures would lower the risk to the construction worker to acceptable levels. It is also unlikely that a future resident would contact groundwater beneath the site due to the availability of public water. Eliminating exposure to groundwater beneath the site would therefore lower the risk to USEPA acceptable levels. Furthermore, the majority of noncarcinogenic risk to the future resident and construction worker is attributable to exposure to manganese, which is a commonly found naturally occurring metal.
- The Area A Weapons Center consists of a well developed area that is characterized by buildings, bunkers, paved areas, and lawns. These features represent an undesirable wildlife habitat. Therefore, it is highly unlikely that organisms inhabiting the area around the site would spend a significant amount of time at the site. Although the ecological risk assessment concluded that

chemicals at the site could adversely impact ecological receptors, the evaluation performed used highly conservative assumptions and the actual risks would be significantly lower. In addition, none of the chemicals detected at this site represent a risk to soil invertebrates. When the current site conditions are factored into this evaluation, it is concluded that the Area A Weapons Center represents little potential risk to ecological receptors.

The exact extent of the "limited action" alternative will be developed during the FS phase of this project. Groundwater monitoring will likely be the major process option in any limited action remedial alternative developed for the Area A Weapons Center; however, access/use restrictions on certain media at the site may be used to augment monitoring in certain limited action plans. The FS will evaluate "limited action" alternatives (for instance, monitoring with and without access/use restrictions) as well as a "no action" alternative and one or more "active remediation" alternatives. A "limited action" alternative may only be implemented at the Area A Wetland Site if it compares favorably in the feasibility study to other "no action" and "active remediation" alternatives.

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TABLE 8-1

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE I RI
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis						
		Target Compound List (TCL)				TAL Metals ⁽²⁾ (Total)	TCLP ⁽³⁾	Radiological ⁽⁴⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽¹⁾			
SOIL								
2WMW4 (0-2)	0-2	● ⁽⁵⁾	●	●	●	●	●	
GROUNDWATER								
012491-2WMW4D	--	●	●	●	●	●		●

1 Polychlorinated biphenyls.

2 Target Analyte List Metals plus boron and cyanide.

3 Toxicity Characteristic Leaching Procedure (TCLP) for metals and pesticides.

4 Radiological analyses include gross alpha and gross beta analyses.

5 ● - Indicates samples analyzed at a fixed-base laboratory.

TABLE 8-2

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)				TAL Metals ⁽¹⁾		TCLP ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾	Radiological ⁽⁶⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽²⁾	Total	Dissolved				
ROUND 1 - SOIL											
2WCMW1S-0002	0-2	● ⁽⁷⁾	●			●					
2WCMW3S-1618	16-18	●	●	●	●	●					
2WCMW3S-1618-D ⁽⁸⁾	16-18	●	●	●	●	●					
2WCTB1-0002	0-2	●	●	●	●	●					
2WCTB2-0002	0-2	●	●	●	●	●					
2WCTB2-0002-D ⁽⁹⁾	0-2	●	●	●	●	●					
2WCTB3-0406	4-6	●	●			●					
2WCTB4-0204	2-4	●	●	●	●	●					
2WCTB5-0608	6-8	●	●			●		●			
2WCTB6-0810	8-10	●	●			●					
2WCTB7-0810	8-10	●	●	●	●	●					
2WCTB8-1012.6	10-12.6	●	●	●	●	●					
ROUND 1 - GROUNDWATER											
2WCGW1S	--	●	●			●	●				
2WCGW1S-D ⁽¹⁰⁾	--	●	●			●	●				
2WCGW2S	--	●	●			●	●				
2WCGW3S	--	●	●			●	●				
2WGW4D	--	●	●			●	●				●

TABLE 8-2 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)				TAL Metals ⁽¹⁾		TCLP ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾	Radiological ⁽⁶⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽²⁾	Total	Dissolved				
ROUND 1 - SEDIMENT											
2WCSD1	0-1	●	●	●	●	●					
2WCSD2	0-1		●			●		●			
2WCSD3	0-1	●	●	●	●	●					
2WCSD4	0-1	●	●	●	●	●					
2WCSD5	0-1	●	●	●	●	●				●	
2WCSD6	0-1		●			●					
2WCSD7	0-1	●	●	●	●	●					
2WCSD8	0-1		●			●					
2WCSD9	0-1		●			●					
2WCSD10	0-1		●			●					
2WCSD11	0-1	●	●	●	●	●			●	●	
2WCSD12	0-1		●			●					
2WCSD13	0-1		●			●					
2WCSD14	0-1		●			●					
2WCSD14-D ⁽¹¹⁾	0-1		●			●					
2WCSD15	0-1		●			●					
ROUND 1 - SURFACE WATER											
2WCSW3	Surface	●	●	●	●	●	●				
2WCSW5	Surface	●	●	●	●	●					

TABLE 8-2 (Continued)
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - PHASE II RI
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)				TAL Metals ⁽¹⁾		TCLP ⁽³⁾	Dioxin ⁽⁴⁾	Engineering ⁽⁵⁾	Radiological ⁽⁶⁾
		Volatiles	Semivolatiles	Pesticides	PCB ⁽²⁾	Total	Dissolved				
ROUND 2 - GROUNDWATER											
2WCGW1S-2	--	●	●			●	●				
2WCGW2S-2	--	●	●			●	●				
2WCGW3S-2	--	●	●			●	●				
2WGW4D-2	--	●	●			●	●				●

1 TAL Metals plus boron. Water samples were also analyzed for hardness.

2 Polychlorinated biphenyls.

3 Toxicity Characteristic Leaching Procedure (TCLP) for metals only.

4 Dioxin analyses includes dioxins and dibenzofurans as specified in U.S. EPA CLP SOW DFLM01.0.

5 Engineering characteristics for sediments include grain size distribution, moisture content, specific gravity, organic content, cation exchange capacity, pH, and total organic carbon content.

6 Radiological analyses include gross alpha and beta and complete gamma spectrum analyses.

7 ● - Indicates samples analyzed at a fixed base laboratory.

8 2WCMW3S-1618-D is a field duplicate of 2WCMW3S-1618.

9 2WCTB2-0002-D is a field duplicate of 2WCTB2-0002.

10 2WCGW1S-D is a field duplicate of 2WCGW1S.

11 2WCSD14-D is a field duplicate of 2WCSD14.

TABLE 8-3
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCMW3S-1618	2WCMW3S-1618-D	2WCTB2-0002	2WCTB2-0002-D	2WCTB3-0406	2WCTB5-0608	2WCTB6-0810
DEPTH (feet):	16 - 18	16 - 18	0 - 2	0 - 2	4 - 6	6 - 8	8 - 10
LOCATION:	2WCMW3S	2WCMW3S	2WCTB2	2WCTB2	2WCTB3	2WCTB5	2WCTB6
ZONE:	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1
SAMPLE DATE:	02/20/94	02/20/94	01/19/94	01/19/94	01/19/94	01/19/94	01/20/94
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
VOLATILES (UG/KG)							
2-BUTANONE	17 U	17 U	11 U	11 U	46	40	240 J
ACETONE	17 U	30 U	12 U	11 U	160 U	160 U	690
CARBON DISULFIDE	11 J	6 J	11 U	11 U	17 U	17 U	14 UJ
TOLUENE	17 U	17 U	11 U	11 U	2 J	17 U	8 J
TRICHLOROETHENE	17 U	17 U	11 U	11 U	17 U	17 U	3 J
SEMIVOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	560 U	560 U	750 U	1100 U	550 U	570 U	480 U
ACENAPHTHENE	560 U	560 U	140 J	1100 U	550 U	570 U	480 U
ACENAPHTHYLENE	560 U	560 U	750 U	1100 U	550 U	570 U	480 U
ANTHRACENE	560 U	560 U	540 J	800 J	30 J	570 U	50 J
BENZO(A)ANTHRACENE	560 UJ	31 J	1300	2100	140 J	79 J	220 J
BENZO(A)PYRENE	29 J	280 J	1300	1800	180 J	100 J	260 J
BENZO(B)FLUORANTHENE	560 UJ	29 J	2300	3200	210 J	200 J	370 J
BENZO(G,H,I)PERYLENE	560 U	560 U	770	960 J	98 J	60 J	140 J
BENZO(K)FLUORANTHENE	29 J	560 UJ	750 U	1100 U	200 J	570 U	260 J
BENZOIC ACID	77 J	56 J	3600 UJ	5400 UJ	370 J	480 J	300 J
BIS(2-ETHYLHEXYL)PHTHALATE	560 U	560 U	750 U	400 U	550 U	570 U	480 U
CARBAZOLE	560 U	560 U	400 J	720 J	550 U	570 U	480 U
CHRYSENE	560 UJ	35 J	1400	2300	220 J	130 J	320 J
DI-N-OCTYL PHTHALATE	560 U	560 UJ	750 U	1100 U	550 U	29 J	69 J
DIBENZO(A,H)ANTHRACENE	560 U	560 U	450 J	570 J	550 U	570 U	68 J
DIBENZOFURAN	560 U	560 U	84 J	1100 U	550 U	570 U	480 U
DIETHYL PHTHALATE	560 U	560 U	750 U	1100 U	28 J	570 U	32 J
FLUORANTHENE	32 J	45 J	3200	5700	220 J	160 J	400 J
FLUORENE	560 U	560 U	180 J	140 J	550 U	570 U	480 U
INDENO(1,2,3-CD)PYRENE	560 U	560 U	760	1000 J	110 J	56 J	160 J
PHENANTHRENE	560 U	560 U	2400	4200	110 J	97 J	190 J
PYRENE	50 J	63 J	2500	4000	310 J	190 J	500
PESTICIDES/PCBs (UG/KG)							
4,4'-DDE	56 U	56 U	4 J	7.4 J			

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TABLE 8-3
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCMW3S-1618	2WCMW3S-1618-D	2WCTB2-0002	2WCTB2-0002-D	2WCTB3-0406	2WCTB5-0608	2WCTB6-0810
DEPTH (feet):	16 - 18	16 - 18	0 - 2	0 - 2	4 - 6	6 - 8	8 - 10
LOCATION:	2WCMW3S	2WCMW3S	2WCTB2	2WCTB2	2WCTB3	2WCTB5	2WCTB6
ZONE:	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1
SAMPLE DATE:	02/20/94	02/20/94	01/19/94	01/19/94	01/19/94	01/19/94	01/20/94
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							

VOLATILES (UG/KG)

2-BUTANONE	17 U	17 U	11 U	11 U	46	40	240 J
ACETONE	17 U	30 U	12 U	11 U	160 U	160 U	690
CARBON DISULFIDE	11 J	6 J	11 U	11 U	17 U	17 U	14 UJ
TOLUENE	17 U	17 U	11 U	11 U	2 J	17 U	8 J
TRICHLOROETHENE	17 U	17 U	11 U	11 U	17 U	17 U	3 J

SEMIVOLATILES (UG/KG)

2-METHYLNAPHTHALENE	560 U	560 U	750 U	1100 U	550 U	570 U	480 U
ACENAPHTHENE	560 U	560 U	140 J	1100 U	550 U	570 U	480 U
ACENAPHTHYLENE	560 U	560 U	750 U	1100 U	550 U	570 U	480 U
ANTHRACENE	560 U	560 U	540 J	800 J	30 J	570 U	50 J
BENZO(A)ANTHRACENE	560 UJ	31 J	1300	2100	140 J	79 J	220 J
BENZO(A)PYRENE	29 J	280 J	1300	1800	180 J	100 J	260 J
BENZO(B)FLUORANTHENE	560 UJ	29 J	2300	3200	210 J	200 J	370 J
BENZO(G,H,I)PERYLENE	560 U	560 U	770	960 J	98 J	60 J	140 J
BENZO(K)FLUORANTHENE	29 J	560 UJ	750 U	1100 U	200 J	570 U	260 J
BENZOIC ACID	77 J	56 J	3600 UJ	5400 UJ	370 J	480 J	300 J
BIS(2-ETHYLHEXYL)PHTHALATE	560 U	560 U	750 U	400 U	550 U	570 U	480 U
CARBAZOLE	560 U	560 U	400 J	720 J	550 U	570 U	480 U
CHRYSENE	560 UJ	35 J	1400	2300	220 J	130 J	320 J
DI-N-OCTYL PHTHALATE	560 U	560 UJ	750 U	1100 U	550 U	29 J	69 J
DIBENZO(A,H)ANTHRACENE	560 U	560 U	450 J	570 J	550 U	570 U	68 J
DIBENZOFURAN	560 U	560 U	84 J	1100 U	550 U	570 U	480 U
DIETHYL PHTHALATE	560 U	560 U	750 U	1100 U	28 J	570 U	32 J
FLUORANTHENE	32 J	45 J	3200	5700	220 J	160 J	400 J
FLUORENE	560 U	560 U	180 J	140 J	550 U	570 U	480 U
INDENO(1,2,3-CD)PYRENE	560 U	560 U	760	1000 J	110 J	56 J	160 J
PHENANTHRENE	560 U	560 U	2400	4200	110 J	97 J	190 J
PYRENE	50 J	63 J	2500	4000	310 J	190 J	500

PESTICIDES/PCBs (UG/KG)

4,4'-DDE	56 U	56 U	4 J	7.4 J			
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TABLE 8-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS

STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCMW3S-1618	2WCMW3S-1618-D	2WCTB2-0002	2WCTB2-0002-D	2WCTB3-0406	2WCTB5-0608	2WCTB6-0810
DEPTH (feet):	16 - 18	16 - 18	0 - 2	0 - 2	4 - 6	6 - 8	8 - 10
LOCATION:	2WCMW3S	2WCMW3S	2WCTB2	2WCTB2	2WCTB3	2WCTB5	2WCTB6
ZONE:	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1	DRAINAGE-1
SAMPLE DATE:	02/20/94	02/20/94	01/19/94	01/19/94	01/19/94	01/19/94	01/20/94
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:							
PESTICIDES/PCBs (UG/KG)							
AROCLOR-1260	560 U	560 U	370 U	370 U			
ENDRIN	56 U	56 U	11 J	14 J			
ENDRIN ALDEHYDE	56 U	56 U	7 J	37 U			
INORGANICS (MG/KG)							
ALUMINUM	17800	13400	9200	9560	18200	16000	14400
ANTIMONY	18.8 U	15.7 U	9.8 U	6.7 U	24.0 U	22.2 U	20.9 U
ARSENIC	8.4	7.6	3.0	3.5	10.8	10.7	9.2
BARIUM	51.7	38.9	38.8	36.4	64.0	49.9	52.4
BERYLLIUM	0.84	0.6	0.41 J	0.48	0.68	0.67 J	0.54 J
BORON	51.8	39.3 J	11.2 UJ	11.7 UJ	25.9 J	30.7 J	16.6 J
CADMIUM	0.68 U	0.47 U	0.45 U	0.47 U	0.67 U	0.67 U	0.62 U
CALCIUM	5050	3520	1330	1310 U	2700	3020	1890
CHROMIUM	41.9	33.1	10.7	11.7	78.7	52.3	67.5
COBALT	8.2	6.8	3.7	2.7	6.6	6.9	5.6
COPPER	17.9	14.9	9.9	11.3	41.4	26.4	39.3
IRON	28000	21100	9680	9880	28600	26700	23900
LEAD	17.2	12.7	12.3 J	13.7 J	66.1 J	22.2 J	43.4 J
MAGNESIUM	8450	6310	2350	2280	7170	6900	5510
MANGANESE	343 J	256 J	167	172	276	229	198
MERCURY	0.17 U	0.12 U	0.11 U	0.12 U	0.29	0.17 U	0.19
NICKEL	22.1	17.8	7.8	6.8	22.7	22.7	17.1
POTASSIUM	4880	3610	1500 J	1310 J	4560 J	4300 J	3490 J
SILVER	0.68 U	0.47 U	0.45 U	0.47 U	1.5	0.67 U	0.81 J
SODIUM	7390	5570	267	268	653	1450	1150
VANADIUM	43.8	32.8	17.5	18.0	49.6	46.1	38.2
ZINC	69.3	53.2	28.7 J	30.1 J	66.7 J	67.5 J	52.0 J

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TABLE 8-3

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WMW4(0-2)	2WCMW1S-0002	2WCTB1-0002	2WCTB4-0204	2WCTB7-0810	2WCTB8-1012.6	
DEPTH (feet):	0 - 2	0 - 2	0 - 2	2 - 4	8 - 10	10 - 12.6	
LOCATION:	2WMW4S	2WCMW1S	2WCTB1	2WCTB4	2WCTB7	2WCTB8	
ZONE:	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	
SAMPLE DATE:	09/26/90	01/18/94	01/18/94	01/18/94	01/19/94	02/20/94	
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:							
VOLATILES (UG/KG)							
2-BUTANONE	11 U	11 U	10 U	10 U	13 U	11 U	
ACETONE	11 U	11 U	6 U	7 U	37 U	11 U	
CARBON DISULFIDE	5 U	11 U	10 U	10 U	13 U	11 U	
TOLUENE	5 U	11 U	10 U	10 U	13 U	11 U	
TRICHLOROETHENE	5 U	11 U	10 U	10 U	13 U	11 U	
SEMI-VOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	350 U	350 U	54 J	38 J	420 U	360 U	
ACENAPHTHENE	350 U	350 U	350 U	340 U	420 U	360 U	
ACENAPHTHYLENE	350 U	350 U	31 J	340 U	420 U	360 U	
ANTHRACENE	350 U	350 U	66 J	340 U	420 U	360 U	
BENZO(A)ANTHRACENE	350 U	350 U	270 J	340 UJ	420 U	33 J	
BENZO(A)PYRENE	350 U	350 U	270 J	340 UJ	22 J	21 J	
BENZO(B)FLUORANTHENE	350 U	350 U	270 J	340 UJ	420 U	27 J	
BENZO(G,H,I)PERYLENE	350 U	350 U	200 J	340 UJ	420 U	360 U	
BENZO(K)FLUORANTHENE	350 U	350 U	220 J	340 UJ	420 U	24 J	
BENZOIC ACID	1700 U	1700 U	1700 U	1700 U	47 J	1800 UJ	
BIS(2-ETHYLHEXYL)PHTHALATE	35 J	350 U	350 U	490 U	420 U	360 J	
CARBAZOLE		350 U	350 U	340 U	420 U	360 U	
CHRYSENE	350 U	350 U	280 J	340 UJ	420 U	42 J	
DI-N-OCTYL PHTHALATE	350 U	350 U	350 U	89 J	420 U	360 UJ	
DIBENZO(A,H)ANTHRACENE	350 U	350 U	350 U	340 UJ	420 U	360 U	
DIBENZOFURAN	350 U	350 U	31 J	340 U	420 U	360 U	
DIETHYL PHTHALATE	350 U	350 U	350 U	340 U	420 U	360 U	
FLUORANTHENE	350 U	350 U	550 J	340 U	420 U	83 J	
FLUORENE	350 U	350 U	85 J	340 U	420 U	360 U	
INDENO(1,2,3-CD)PYRENE	350 U	350 U	170 J	340 UJ	420 U	360 U	
PHENANTHRENE	350 U	350 U	440	340 U	420 U	54 J	
PYRENE	350 U	350 U	560	340 UJ	420 U	70 J	
PESTICIDES/PCBs (UG/KG)							
4,4'-DDE	17 U		35 U	34 U	42 U	36 U	

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TABLE 8-3
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	2WMW4(0-2)	2WCMW1S-0002	2WCTB1-0002	2WCTB4-0204	2WCTB7-0810	2WCTB8-10126	
DEPTH (feet):	0 - 2	0 - 2	0 - 2	2 - 4	8 - 10	10 - 12.6	
LOCATION:	2WMW4S	2WCMW1S	2WCTB1	2WCTB4	2WCTB7	2WCTB8	
ZONE:	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	DRAINAGE-3	
SAMPLE DATE:	09/26/90	01/18/94	01/18/94	01/18/94	01/19/94	02/20/94	11
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:							
PESTICIDES/PCBs (UG/KG)							
AROCOR-1260	50 J		350 U	340 U	420 U	360 U	
ENDRIN	17 U		11 J	34 U	42 UJ	36 U	
ENDRIN ALDEHYDE			35 U	34 U	6.4 J	36 U	
INORGANICS (MG/KG)							
ALUMINUM	4810	6040	6360	11100	15200	9560	
ANTIMONY	12.6 UR	4.7 J	5.4 J	7.7 R	13.2 U	11.3 U	
ARSENIC	0.77	1.8 U	1.9 U	1.6 U	4.5	3.0	
BARIUM	27.4	27.5 J	60.8 J	131	38.5	49.4	
BERYLLIUM	0.21 U	0.32 J	0.23 J	0.33 J	0.57	0.41	
BORON	42.0 R	10.6 U	10.4 U	10.4 U	13.1 UJ	12.2 U	
CADMIUM	1.2	0.43 J	0.42 U	0.42 U	0.52 U	0.49 U	
CALCIUM	758 J	863 J	1870 J	2080 J	1650	1620	
CHROMIUM	5.9 J	10.9	10.8	21.0	17.7	12.5	
COBALT	4.5	4.5 J	4.6 J	8.6 J	4.4	4.5	
COPPER	6.7 J	8.6 J	10.8 J	15.2 J	12.3	10.3	
IRON	6540	9200	10800	20800	12100	12900	
LEAD	3.6 J	3.5	8.3	2.4 J	5.3 J	6.7	
MAGNESIUM	1660 J	2240	3520	6910	3070	3870	
MANGANESE	121	137	257	390	122	230 J	
MERCURY	0.1 U	0.11 U	0.1 U	0.1 U	0.13 U	0.12 U	
NICKEL	4.4	5.4 J	8.4 J	9.4 J	13.7	8.6	
POTASSIUM	1170	1390 J	2900	6300	849 J	2470	
SILVER	1.7 UJ	0.43 U	0.42 U	0.42 U	0.65 J	0.49 U	
SODIUM	152 J	214 J	213 J	264 J	452	312	
VANADIUM	9.8	13.5 J	17.5 J	46.1	23.5	21.8	
ZINC	19.6 J	17.8 J	46.5 J	49.0 J	27.2 J	43.1	

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TABLE 8-4**SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SOIL)
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WCTB5-0608	2WMW4(0-2)					
INVESTIGATION:	PH2-1	PH1					
SAMPLE DATE:	01/19/94	09/26/90					
LOCATION:	2WCTB5	2WMW4S					
SAMPLE TYPE:	GRAB	GRAB					
STATUS:							
TCLP METALS (MGL)*							
ARSENIC (5.0/0.5)	0.0317 J	0.100 U					
BARIUM (100.0/10.0)	0.0317	0.0830					
CHROMIUM (5.0/0.5)	0.0043 J	0.0500 U					
SELENIUM (1.0/0.5)	0.209	0.100 U					

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 8-5
SUMMARY OF PHASE I AND PHASE II SOIL ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	Surface Soil (<2 Feet) (1)			Subsurface Soil (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
2-Butanone	0/4	-	ND (3)	3/7	40-240	2WCTB6
Acetone	0/4	-	ND	1/7	690	2WCTB6
Carbon disulfide	0/4	-	ND	1/7	11	2WCMW3S
Toluene	0/4	-	ND	2/7	2-8	2WCTB6
Trichloroethene	0/4	-	ND	1/7	3	2WCTB6
SEMIVOLATILE ORGANICS (ug/kg)						
2-Methylnaphthalene	1/4	54	2WCTB1	1/7	38	2WCTB4
Acenaphthene	1/4	140	2WCTB2	0/7	-	ND
Acenaphthylene	1/4	31	2WCTB1	0/7	-	ND
Anthracene	2/4	66-800	2WCTB2	2/7	30-50	2WCTB6
Benzo(a)anthracene	2/4	270-2100	2WCTB2	5/7	31-220	2WCTB6
Benzo(a)pyrene	2/4	270-1800	2WCTB2	6/7	21-280	2WCMW3S
Benzo(b)fluoranthene	2/4	270-3200	2WCTB2	5/7	27-370	2WCTB6
Benzo(g,h,i)perylene	2/4	200-960	2WCTB2	3/7	60-140	2WCTB6
Benzo(k)fluoranthene	1/4	220	2WCTB1	4/7	24-260	2WCTB6
Benzoic acid	0/4	-	ND	5/7	47-480	2WCTB5
Bis(2-ethylhexyl)phthalate	1/4	35	2WMW4	1/7	360	2WCTB8
Carbazole	1/4	720	2WCTB2	0/7	-	ND
Chrysene	2/4	280-2300	2WCTB2	5/7	35-320	2WCTB6
Di-n-octyl phthalate	0/4	-	ND	3/7	29-89	2WCTB4
Dibenzo(a,h)anthracene	1/4	570	2WCTB2	1/7	68	ND
Dibenzofuran	2/4	31-84	2WCTB2	0/7	-	ND
Diethyl phthalate	0/4	-	ND	2/7	28-32	2WCTB6
Fluoranthene	2/4	550-5700	2WCTB2	5/7	45-400	2WCTB6
Fluorene	2/4	85-180	2WCTB2	0/7	-	ND
Indeno(1,2,3-cd)pyrene	2/4	170-1000	2WCTB2	3/7	56-160	2WCTB6

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TABLE 8-5
SUMMARY OF PHASE I AND PHASE II SOIL ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT
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Analyte	Surface Soil (<2 Feet) (1)			Subsurface Soil (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Phenanthrene	2/4	440-4200	2WCTB2	4/7	54-190	2WCTB6
Pyrene	2/4	560-4000	2WCTB2	5/7	63-500	2WCTB6
PESTICIDES/PCBs (ug/kg)						
4,4'-DDE	1/3	7.4	2WCTB2	0/4	-	ND
Endrin	2/3	11-14	2WCTB2	0/4	-	ND
Endrin aldehyde	1/3	7	2WCTB2	1/4	6.4	2WCTB7
Aroclor-1260	1/3	50	2WMW4	0/4	-	ND
INORGANICS (mg/kg)						
Aluminum	4/4	4810-9560	2WCTB2	7/7	9560-18200	2WCTB3
Antimony	2/4	4.7-5.4	2WCTB1	0/6	-	ND
Arsenic	2/4	0.77-3.5	2WCTB2	6/7	3-10.8	2WCTB3
Barium	4/4	27.4-60.8	2WCTB1	7/7	38.5-131	2WCTB4
Beryllium	3/4	0.23-0.48	2WCTB2	7/7	0.33-0.84	2WCMW3S
Boron	0/4	-	ND	4/7	16.6-51.8	2WCMW3S
Cadmium	2/4	0.43-1.2	2WMW4	0/7	-	ND
Calcium	4/4	758-1870	2WCTB1	7/7	1620-5050	2WCMW3S
Chromium	4/4	5.9-11.7	2WCTB2	7/7	12.5-78.7	2WCTB3
Cobalt	4/4	3.7-4.6	2WCTB1	7/7	4.4-8.6	2WCTB4
Copper	4/4	6.7-11.3	2WCTB2	7/7	10.3-41.4	2WCTB3
Iron	4/4	6540-10800	2WCTB1	7/7	12100-28600	2WCTB3
Lead	4/4	3.5-13.7	2WCTB2	7/7	2.4-66.1	2WCTB3
Magnesium	4/4	1660-3520	2WCTB1	7/7	3070-8450	2WCMW3S
Manganese	4/4	121-257	2WCTB1	7/7	122-390	2WCTB4
Mercury	0/4	-	ND	2/7	0.19-0.29	2WCTB3
Nickel	4/4	4.4-8.4	2WCTB1	7/7	8.6-22.7	2WCTB3
Potassium	4/4	1170-2900	2WCTB1	7/7	849-6300	2WCTB4
Silver	0/4	-	ND	3/7	0.65-1.5	2WCTB3

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TABLE 8-5
SUMMARY OF PHASE I AND PHASE II SOIL ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT
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Analyte	Surface Soil (<2 Feet) (1)			Subsurface Soil (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Sodium	4/4	152-268	2WCTB2	7/7	264-7390	2WCMW3S
Vanadium	4/4	9.8-18	2WCTB2	7/7	21.8-49.6	2WCTB3
Zinc	4/4	17.8-46.5	2WCTB1	7/7	27.2-69.3	2WCMW3S
TCLP METALS (mg/L)						
Arsenic (5.0/0.5) (4)	0/1	-	ND	1/1	0.0317	2WCTB5
Barium (100.0/10)	1/1	0.0830	2WMW4	1/1	0.0317	2WCTB5
Chromium (5.0/0.5)	0/1	-	ND	1/1	0.0043	2WCTB5
Selenium (1.0/0.5)	0/1	-	ND	1/1	0.209	2WCTB5

- 1 Includes samples 2WMW4 (0-2), 2WCMW1S-0002, 2WCTB1-0002, 2WCTB2-0002, and 2WCTB2-0002-D (field duplicate of 2WCTB2-0002). Duplicate soil sample results are counted as one sample; maximum value is used for evaluation.
- 2 Includes samples 2WCMW3S-1618, 2WCMW3S-1618-D (field duplicate of 2WCMW3S-1618), 2WCTB3-0406, 2WCTB4-0204, 2WCTB5-0608, 2WCTB6-0810, 2WCTB7-0810, and 2WCTB8-1012.6. Duplicate soil sample results are counted as one sample; maximum value is used for evaluation.
- 3 ND - Not Detected.
- 4 Values in parentheses represent Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Clean-Up Standard Pollutant Mobility Criteria for GB Waters.

TABLE 8-6

RESULTS OF OVA HEADSPACE ANALYSIS OF SUBSURFACE SOILS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Sample Location	Date	Sample Depth (Feet)	Result (PPM)
2WCTB1	01/18/94	00-02	11.0*
2WCTB1	01/18/94	02-04	1.0
2WCTB1	01/18/94	04-06	<1.0
2WCTB1	01/18/94	06-08	<1.0
2WCTB4	01/18/94	00-02	<1.0
2WCTB4	01/18/94	02-04	<1.0*
2WCMW1S	01/18/94	00-02	1.0*
2WCMW1S	01/18/94	02-04	<1.0
2WCMW1S	01/18/94	04-06	<1.0
2WCMW1S	01/18/94	06-08	<1.0
2WCMW1S	01/18/94	08-10	<1.0
2WCTB7	01/19/94	02-03	4.0
2WCTB7	01/19/94	04-06	<1.0
2WCTB7	01/19/94	06-08	<1.0
2WCTB7	01/19/94	08-10	7.0*
2WCTB3	01/19/94	00-02	<1.0
2WCTB3	01/19/94	02-04	4.0
2WCTB3	01/19/94	04-06	7.0*
2WCTB2	01/19/94	00-02	9.0*
2WCTB2	01/19/94	02-04	<1.0
2WCTB2	01/19/94	04-06	<1.0
2WCTB2	01/19/94	06-08	<1.0
2WCTB2	01/19/94	08-10	<1.0
2WCTB2	01/19/94	10-12	4.0
2WCTB2	01/19/94	12-14	<1.0
2WCTB5	01/19/94	00-02	<1.0
2WCTB5	01/19/94	02-04	7.0

TABLE 8-6 (Continued)
RESULTS OF OVA HEADSPACE ANALYSIS OF SUBSURFACE SOILS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Sample Location	Date	Sample Depth (Feet)	Result (PPM)
2WCTB5	01/19/94	04-06	<1.0
2WCTB5	01/19/94	06-08	7.0*
2WCTB5	01/19/94	08-10	<1.0
2WCTB5	01/19/94	10-12	9.0
2WCTB5	01/19/94	12-14	<1.0
2WCTB6	01/20/94	00-02	<1.0
2WCTB6	01/20/94	02-04	<1.0
2WCTB6	01/20/94	04-06	<1.0
2WCTB6	01/20/94	06-08	<1.0
2WCTB6	01/20/94	08-10	<1.0
2WCTB6	01/20/94	10-12	<1.0
2WCTB6	01/20/94	12-14	<1.0

* Denotes samples sent to a fixed base laboratory for analysis.

TABLE 8-7

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCGW1S	2WCGW1S	2WCGW1S-D	2WCGW1S-2	2WCGW1S-D	2WCGW1S-2	2WCGW2S
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-2	PH2-1	PH2-2	PH2-1
SAMPLE DATE:	04/05/94	04/05/94	04/05/94	07/11/94	04/05/94	07/11/94	04/05/94
LOCATION:	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW2S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered

VOLATILES (UG/L)

1,1,2-TRICHLOROETHANE	10 U			10 U	10 U		10 U
1,2-DICHLOROETHANE	10 U			10 U	10 U		10 U
2-BUTANONE	10 U			10 U	10 U		10 U
2-HEXANONE	10 U			10 U	10 U		10 U
4-METHYL-2-PENTANONE	10 U			10 U	10 U		10 U
TRICHLOROETHENE	10 U			10 U	10 U		10 U

SEMI-VOLATILES (UG/L)

1,3-DICHLOROBENZENE	0.6 J			10 U	10 U		10 U
BENZO(G,H,I)PERYLENE	10 U			1 J	10 U		10 U
BENZOIC ACID	50 U			50 U	50 U		50 U
BIS(2-ETHYLHEXYL)PHTHALATE	10 U			3 J	42 U		10 U
DI-N-OCTYL PHTHALATE	10 U			10 U	10 U		10 U
DIBENZO(A,H)ANTHRACENE	10 U			0.8 J	10 U		10 U
INDENO(1,2,3-CD)PYRENE	10 U			1 J	10 U		10 U

INORGANICS (UG/L)

ALUMINUM	1700	36.5 U	37.3 U	1090 J	2970	29.4 U	103 U
ANTIMONY	13.0 U	13.0 U	13.0 U	12.0 R	13.0 U	12.0 UJ	13.0 U
ARSENIC	6.0 J	7.3	6.5	8.7 J	7.8 J	7.3 J	4.9 J
BARIUM	86.0 J	73.4	71.0	189 J	89.9 J	210 J	72.4 J
BERYLLIUM	1.2 J	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 UJ	1.3 J
BORON	498	582	569	3550 J	520	3740 J	75.1 U
CALCIUM	121000	110000	110000	106000 J	116000	111000 J	41000
CHROMIUM	6.7 J	4.0 U	4.0 U	6.8 J	4.2 J	5.8 U	4.0 U
COBALT	15.5 J	16.6 U	15.4 U	4.8 J	14.7 J	11.0 U	6.9 J
COPPER	5.0 U	5.0 U	5.0 U	12.8 J	9.5 J	7.9 U	5.0 U
IRON	40000	35000	35400	13800 J	38800	9340 J	68000
LEAD	2.7 J	2.0 UJ	2.0 UJ	5.1 U	4.7 J	2.0 UJ	2.0 UJ
MAGNESIUM	34000	35500	34400	186000 J	33900	180000 J	5250
MANGANESE	4490	5080	5110	4980 J	4620	5220 J	4530
NICKEL	11.0 U	11.0 U	14.0	7.0 UJ	11.0 U	7.0 UJ	11.0 U
POTASSIUM	15600	17800	17300	95700 J	16300	97500 J	9050

TABLE 8-7
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCGW1S	2WCGW1S	2WCGW1S-D	2WCGW1S-2	2WCGW1S-D	2WCGW1S-2	2WCGW2S
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-2	PH2-1	PH2-2	PH2-1
SAMPLE DATE:	04/05/94	04/05/94	04/05/94	07/11/94	04/05/94	07/11/94	04/05/94
LOCATION:	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW1S	2WCMW2S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Unfiltered	Filtered	Filtered	Unfiltered	Unfiltered	Filtered	Unfiltered
INORGANICS (UG/L)							
SELENIUM	1.0 UJ	1.0 UJ	1.0 UJ	5.0 UJ	1.0 UJ	5.0 UJ	1.0 U
SILVER	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 U	2.0 UJ	2.0 U
SODIUM	164000	198000	188000	1900000 J	171000	1760000 J	66900
THALLIUM	10.0 UJ	10.0 UJ	10.0 UJ	5.6 J	10.0 UJ	5.0 UJ	13.8 J
VANADIUM	4.0 U	4.0 U	4.0 U	9.8 J	4.0 U	2.9 J	4.0 U
ZINC	29.4	19.6 U	19.0 U	7.4 U	41.7	2.0 UJ	5.4
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO ₃	64	436	428	1530	448		124

TABLE 8-7

**SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WCGW2S	2WCGW2S-2	2WCGW2S-2	2WCGW3S	2WCGW3S	2WCGW3S-2	2WCGW3S-2
INVESTIGATION:	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	04/05/94	07/11/94	07/11/94	03/31/94	03/31/94	07/10/94	07/10/94
LOCATION:	2WCMW2S	2WCMW2S	2WCMW2S	2WCMW3S	2WCMW3S	2WCMW3S	2WCMW3S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

VOLATILES (UG/L)

1,1,2-TRICHLOROETHANE		10 U		10 U		10 U	
1,2-DICHLOROETHANE		10 U		10 U		10 U	
2-BUTANONE		10 U		10 U		10 U	
2-HEXANONE		10 U		10 U		10 U	
4-METHYL-2-PENTANONE		10 U		10 U		10 U	
TRICHLOROETHENE		10 U		10 U		10 U	

SEMI-VOLATILES (UG/L)

1,3-DICHLOROBENZENE		10 U		10 U		10 U	
BENZO(G,H,I)PERYLENE		10 U		10 U		10 U	
BENZOIC ACID		50 U		50 U		50 U	
BIS(2-ETHYLHEXYL)PHTHALATE		10 U		2 J		2 J	
DI-N-OCTYL PHTHALATE		10 U		10 U		10 U	
DIBENZO(A,H)ANTHRACENE		10 U		10 U		10 U	
INDENO(1,2,3-CD)PYRENE		10 U		10 U		10 U	

INORGANICS (UG/L)

ALUMINUM	33.8 U	56.6 U	45.9 U	8330	40.5 U	9210 J	27.6 U
ANTIMONY	13.0 U	12.0 U	12.0 U	13.0 U	15.2 J	12.0 R	16.4 U
ARSENIC	6.1	5.0 UJ	5.0 U	11.9	3.1 J	19.9 J	8.4 J
BARIUM	73.7	42.3	44.3	98.5 J	46.5 J	158 J	125 J
BERYLLIUM	1.2 U	1.0 U	1.0 U	1.0 J	1.2 J	1.4 J	1.0 UJ
BORON	75.3	82.4	72.2	1370	1220	3540 J	3810 J
CALCIUM	40900	26500	26400	104000	89100	264000 J	298000 J
CHROMIUM	4.0 U	3.0 U	3.7 U	24.9	4.0 U	21.4 J	8.2 U
COBALT	5.0 U	3.0 U	3.0 U	13.4 J	5.0 U	5.9 J	3.0 UJ
COPPER	5.0 U	2.0 U	2.0 U	33.5	5.0 U	38.5 J	23.0 J
IRON	69200	43100	43700 J	20400	4610	22000 J	10300 J
LEAD	2.0 UJ	2.0 UJ	2.0 U	2.0 UJ	2.0 UJ	16.8 J	2.0 UJ
MAGNESIUM	5220	3560	3520	132000	115000	448000 J	471000 J
MANGANESE	4580	2800	2820	3630	3070	6500 J	6540 J
NICKEL	11.0 U	7.0 U	7.0 U	20.0 J	11.0 UJ	7.0 UJ	10.3 J
POTASSIUM	8510	7150	7190	68400	59400	173000 J	182000 J

TABLE 8-7

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCGW2S	2WCGW2S-2	2WCGW2S-2	2WCGW3S	2WCGW3S	2WCGW3S-2	2WCGW3S-2
INVESTIGATION:	PH2-1	PH2-2	PH2-2	PH2-1	PH2-1	PH2-2	PH2-2
SAMPLE DATE:	04/05/94	07/11/94	07/11/94	03/31/94	03/31/94	07/10/94	07/10/94
LOCATION:	2WCMW2S	2WCMW2S	2WCMW2S	2WCMW3S	2WCMW3S	2WCMW3S	2WCMW3S
SCREEN DEPTH:	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
FILTERING:	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered

INORGANICS (UG/L)

SELENIUM	1.0 U	5.0 UJ	5.0 UJ	3.0 UJ	3.0 UJ	5.0 UJ	5.0 UJ
SILVER	3.7	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ
SODIUM	67500	43900	44000	948000	847000	3570000 J	3580000 J
THALLIUM	10.0 UJ	5.0 U	5.0 U	1.0 UJ	1.5 U	5.7 J	5.0 UJ
VANADIUM	4.0 U	3.0 U	1.0 U	21.6 J	4.0 U	25.3 J	3.1 J
ZINC	8.0 U	3.4 U	3.7 U	52.0	14.2 J	30.5 J	2.0 UJ

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO ₃	125	78		860		4000	
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TABLE 8-7
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	012491-2WMW4D	2WGW4D	2WGW4D	2WGW4D-2	2WGW4D-2		
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2		
SAMPLE DATE:	01/24/91	04/05/94	04/05/94	07/11/94	07/11/94	//	//
LOCATION:	2WMW4D	2WMW4D	2WMW4D	2WMW4D	2WMW4D		
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep		
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered		

VOLATILES (UG/L)

1,1,2-TRICHLOROETHANE	5 U	2 J		10 U			
1,2-DICHLOROETHANE	5 U	1 J		10 U			
2-BUTANONE	10 U	10 U		4 J			
2-HEXANONE	10 U	12		10 U			
4-METHYL-2-PENTANONE	10 U	12		10 U			
TRICHLOROETHENE	5 U	2 J		10 U			

SEMI-VOLATILES (UG/L)

1,3-DICHLOROBENZENE	10 U	10 U		10 U			
BENZO(G,H,I)PERYLENE	10 U	10 U		10 U			
BENZOIC ACID	50 U	7 J		50 U			
BIS(2-ETHYLHEXYL)PHTHALATE	2 J	36 U		2 J			
DI-N-OCTYL PHTHALATE	10 U	2 J		10 U			
DIBENZO(A,H)ANTHRACENE	10 U	10 U		10 U			
INDENO(1,2,3-CD)PYRENE	10 U	10 U		10 U			

INORGANICS (UG/L)

ALUMINUM	30.0 U	182 U	19.2 U	291	31.8 U		
ANTIMONY	25.0 U	13.0 U	16.9	12.0 U	12.9 U		
ARSENIC	3.0 U	2.0 U	2.0 U	5.0 UJ	5.0 U		
BARIUM	70.1	93.8 J	81.9	135	113		
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
BORON	1.4 R	35.9 U	50.0 U	17.3 U	15.2 U		
CALCIUM	28700	33800	32400	40900	40700		
CHROMIUM	5.0 U	4.0 U	4.0 U	3.0 U	3.0 UJ		
COBALT	5.0 U	5.0 U	5.0 U	3.0 U	3.0 U		
COPPER	5.0 U	5.0 U	5.0 U	3.9 J	2.0 U		
IRON	65.2 J	3220	25.3 U	7180	67.7 U		
LEAD	2.0 UR	2.7 J	2.0 UJ	5.0 U	2.0 U		
MAGNESIUM	2850	3100 J	3110	3520	3460		
MANGANESE	31.1	56.0	33.6	405	267		
NICKEL	18.6 J	11.0 U	11.0 U	7.0 U	7.0 U		
POTASSIUM	1170	1330 J	1390	1570	1920 U		

TABLE 8-7
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	012491-2WMW4D	2WGW4D	2WGW4D	2WGW4D-2	2WGW4D-2		
INVESTIGATION:	PH1	PH2-1	PH2-1	PH2-2	PH2-2		
SAMPLE DATE:	01/24/91	04/05/94	04/05/94	07/11/94	07/11/94	//	//
LOCATION:	2WMW4D	2WMW4D	2WMW4D	2WMW4D	2WMW4D		
SCREEN DEPTH:	Deep	Deep	Deep	Deep	Deep		
FILTERING:	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered		
INORGANICS (UG/L)							
SELENIUM	1.0 UJ	1.0 U	1.0 U	6.0 J	5.0 UJ		
SILVER	7.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U		
SODIUM	9020 J	8270	8420	9010	9360		
THALLIUM	2.0 UR	1.0 U	1.0 UJ	5.0 U	5.0 U		
VANADIUM	20.0 U	4.0 U	4.0 U	3.0 U	1.0 U		
ZINC	15.0 J	8.8 J	7.5 U	20.0 U	2.3 U		
RADIONUCLIDES (PC/L)							
GROSS ALPHA	10.1 +/- 3.00	11 +/- 2.00 J		20 +/- 3.00			
GROSS BETA	4.4 +/- 3.00	5 +/- 1.00 J		22 +/- 2.00			
MISCELLANEOUS PARAMETERS (MG/L)							
HARDNESS as CaCO3		92	94.0	118			

TABLE 8-8

SUMMARY OF PHASE I GROUNDWATER ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Analyte	2WMW4D
SEMIVOLATILE ORGANICS (ug/L)	
Bis(2-Ethylhexyl)phthalate	2
INORGANICS (ug/L)	
Barium	70.1
Calcium	28700
Iron	65.2
Magnesium	2850
Manganese	31.1
Nickel	18.6
Potassium	1170
Sodium	9020
Zinc	15

TABLE 8-9

**SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Analyte	Phase II - Round 1											
	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
1,1,2-Trichloroethane	0/3	-	ND (3)	-	-	NA (4)	1/1	2	2WGW4D	-	-	NA
1,2-Dichloroethane	0/3	-	ND	-	-	NA	1/1	1	2WGW4D	-	-	NA
2-Hexanone	0/3	-	ND	-	-	NA	1/1	12	2WGW4D	-	-	NA
4-Methyl-2-pentanone	0/3	-	ND	-	-	NA	1/1	12	2WGW4D	-	-	NA
Trichloroethene	0/3	-	ND	-	-	NA	1/1	2	2WGW4D	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
1,3-Dichlorobenzene	1/3	0.6	2WCGW1S	-	-	NA	0/1	-	ND	-	-	NA
Benzoic acid	0/3	-	ND	-	-	NA	1/1	7	2WGW4D	-	-	NA
Bis(2-ethylhexyl)phthalate	1/3	2	2WCGW3S	-	-	NA	0/1	-	ND	-	-	NA
Di-n-octyl phthalate	0/3	-	ND	-	-	NA	1/1	2	2WGW4D	-	-	NA
INORGANICS (ug/L)												
Aluminum	2/3	2335-8330	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Antimony	0/3	-	ND	1/3	15.2	2WCGW3S	0/1	-	ND	1/1	16.9	2WGW4D
Arsenic	3/3	4.9-11.9	2WCGW3S	3/3	6.9	2WCGW1S	0/1	-	ND	0/1	-	ND
Barium	3/3	72.4-98.5	2WCGW3S	3/3	46.5-73.7	2WCGW2S	1/1	93.8	2WGW4D	1/1	81.9	2WGW4D
Beryllium	3/3	0.85-1.3	2WCGW2S	1/3	1.2	2WCGW3S	0/1	-	ND	0/1	-	ND
Boron	2/3	509-1370	2WCGW3S	3/3	75.3-1220	2WCGW3S	0/1	-	ND	0/1	-	ND
Calcium	3/3	41000-118500	2WCGW1S	3/3	40900-110000	2WCGW1S	1/1	33800	2WGW4D	1/1	32400	2WGW4D
Chromium	2/3	5.45-24.9	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Cobalt	3/3	6.9-15.1	2WCGW1S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Copper	2/3	6-33.5	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Iron	3/3	20400-68000	2WCGW2S	3/3	4610-69200	2WCGW2S	1/1	3220	2WGW4D	0/1	-	ND
Lead	1/3	3.7	2WCGW1S	0/3	-	ND	1/1	2.7	2WGW4D	0/1	-	ND
Magnesium	3/3	5250-132000	2WCGW3S	3/3	5220-115000	2WCGW3S	1/1	3100	2WGW4D	1/1	3110	2WGW4D
Manganese	3/3	3630-4555	2WCGW1S	3/3	3070-5095	2WCGW1S	1/1	56	2WGW4D	1/1	33.6	2WGW4D
Nickel	1/3	20	2WCGW3S	1/3	9.75	2WCGW1S	0/1	-	ND	0/1	-	ND
Potassium	3/3	9050-68400	2WCGW3S	3/3	8510-59400	2WCGW3S	1/1	1330	2WGW4D	1/1	1390	2WGW4D
Silver	0/3	-	ND	1/3	3.7	2WCGW2S	0/1	-	ND	0/1	-	ND
Sodium	3/3	66900-948000	2WCGW3S	3/3	67500-847000	2WCGW3S	1/1	8270	2WGW4D	1/1	8420	2WGW4D
Thallium	1/3	13.8	2WCGW2S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Vanadium	1/3	21.6	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Zinc	3/3	5.4-52	2WCGW3S	1/3	14.2	2WCGW3S	1/1	8.8	2WGW4D	0/1	-	ND
MISCELLANEOUS (mg/L)												
Hardness as CaCO3	3/3	124-860	2WCGW3S	2/2	125-432	2WCGW1S	1/1	92	2WGW4D	1/1	94	2WGW4D

1 Includes samples 2WCGW1S, 2WCGW1S-D (field duplicate of 2WCGW1S), 2WCGW2S, and 2WCGW3S. Duplicate groundwater sample results are averaged and counted as one sample.

2 Includes sample 2WGW4D.

3 Not Detected.

4 Not Analyzed.

TABLE 8-10

**SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Analyte	Phase II - Round 2											
	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
2-Butanone	0/3	-	ND (3)	-	-	NA (4)	1/1	4	2WGW4D	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
Benzo(g,h,i)perylene	1/3	1	2WCGW1S	-	-	NA	0/1	-	ND	-	-	NA
Bis(2-Ethylhexyl)phthalate	2/3	2-3	2WCGW1S	-	-	NA	1/1	2	2WGW4D	-	-	NA
Dibenzo(a,h)anthracene	1/3	0.8	2WCGW1S	-	-	NA	0/1	-	ND	-	-	NA
Indeno(1,2,3-Cd)pyrene	1/3	1	2WCGW1S	-	-	NA	0/1	-	ND	-	-	NA
INORGANICS (ug/L)												
Aluminum	2/3	1090-9210	2WCGW3S	0/3	-	ND	1/1	291	2WGW4D	0/1	-	ND
Arsenic	2/3	8.7-19.9	2WCGW3S	2/3	7.3-8.4	2WCGW3S	0/1	-	ND	0/1	-	ND
Barium	3/3	42.3-189	2WCGW1S	3/3	44.3-210	2WCGW1S	1/1	135	2WGW4D	1/1	113	2WGW4D
Beryllium	1/3	1.4	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Boron	3/3	82.4-3550	2WCGW1S	3/3	72.2-3810	2WCGW3S	0/1	-	ND	0/1	-	ND
Calcium	3/3	26500-264000	2WCGW3S	3/3	26400-298000	2WCGW3S	1/1	40900	2WGW4D	1/1	40700	2WGW4D
Chromium	2/3	6.8-21.4	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Cobalt	2/3	4.8-5.9	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Copper	2/3	12.8-38.5	2WCGW3S	1/3	23	2WCGW3S	1/1	3.9	2WGW4D	0/1	-	ND
Iron	3/3	13800-43100	2WCGW2S	3/3	9340-43700	2WCGW2S	1/1	7180	2WGW4D	0/1	-	ND
Lead	1/3	16.8	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Magnesium	3/3	3560-448000	2WCGW3S	3/3	3520-471000	2WCGW3S	1/1	3520	2WGW4D	1/1	3460	2WGW4D
Manganese	3/3	2800-6500	2WCGW3S	3/3	2820-6540	2WCGW3S	1/1	405	2WGW4D	1/1	267	2WGW4D
Nickel	0/3	-	ND	1/3	10.3	2WCGW3S	0/1	-	ND	0/1	-	ND
Potassium	3/3	7150-173000	2WCGW3S	3/3	7190-182000	2WCGW3S	1/1	1570	2WGW4D	0/1	-	ND
Selenium	0/3	-	ND	0/3	-	ND	1/1	6	2WGW4D	0/1	-	ND
Sodium	3/3	43900-3570000	2WCGW3S	3/3	44000-3580000	2WCGW3S	1/1	9010	2WGW4D	1/1	9360	2WGW4D
Thallium	2/3	5.6-5.7	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
Vanadium	2/3	9.8-25.3	2WCGW3S	2/3	2.9-3.1	2WCGW3S	0/1	-	ND	0/1	-	ND
Zinc	1/3	30.5	2WCGW3S	0/3	-	ND	0/1	-	ND	0/1	-	ND
MISCELLANEOUS												
Hardness as CaCO ₃	3/3	78-4000	2WCGW3S	-	-	NA	1/1	118	2WGW4D	-	-	NA

1 Includes samples 2WCGW1S-2, 2WCGW2S-2, and 2WCGW3S-2.

2 Includes sample 2WGW4D-2.

3 ND - Not Detected.

4 NA - Not Analyzed.

TABLE 8-11

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSW3	2WCSW3	2WCSW5				
LOCATION:	2WCSW3	2WCSW3	2WCSW5				
SAMPLE DATE:	12/19/93	12/19/93	12/19/93	//	//	//	//
INVESTIGATION:	PH2-1	PH2-1	PH2-1				
FILTERING:	Filtered	Unfiltered	Unfiltered				

SEMI-VOLATILES (UG/L)

BUTYL BENZYL PHTHALATE		2 J	10 U				
DI-N-OCTYL PHTHALATE		1 J	10 U				

INORGANICS (UG/L)

ARSENIC	2.1 J	2.6 J	2.0 U				
BARIUM	5.0 U	5.0 U	6.8 J				
CADMIUM	5.6	6.6	2.0 U				
CALCIUM	1540	1490	3310				
IRON	56.6 U	217	1100				
LEAD	1.0 J	3.9	7.0				
MAGNESIUM	344	366	618				
MANGANESE	24.7	28.1	48.0				
SODIUM	2750	2620	2990				
ZINC	120	135	27.0 U				

MISCELLANEOUS PARAMETERS (MG/L)

HARDNESS as CaCO ₃		20	12				
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TABLE 8-12

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS

STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD1	2WCSD11	2WCSD14	2WCSD14D	2WCSD15	2WCSD2	2WCSD3
LOCATION:	2WCSD1	2WCSD11	2WCSD14	2WCSD14	2WCSD15	2WCSD2	2WCSD3
ZONE:	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1
SAMPLE DATE:	03/09/94	12/20/93	12/21/93	12/21/93	12/21/93	03/09/94	03/09/94
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB

VOLATILES (UG/KG)

1,1,1-TRICHLOROETHANE	17 U	12 U					17 U
METHYLENE CHLORIDE	17 U	12 J					17 U
TETRACHLOROETHENE	17 UJ	12 U					17 UJ
TOLUENE	2 J	12 U					17 UJ
TRICHLOROETHENE	17 U	12 U					17 U

SEMIVOLATILES (UG/KG)

2-METHYLNAPHTHALENE	550 U	410 U	660 U	600 U	690 U	720 U	570 U
ACENAPHTHENE	550 U	410 U	70 J	60 J	690 U	36 J	79 J
ACENAPHTHYLENE	550 U	410 U	74 J	65 J	690 U	720 U	47 J
ANTHRACENE	22 J	410 UJ	290 J	290 J	51 J	95 J	400 J
BENZO(A)ANTHRACENE	110 J	410 UJ	1800	1900	160 J	510 J	3400
BENZO(A)PYRENE	120 J	410 UJ	2700	2500	690 U	610 J	4400
BENZO(B)FLUORANTHENE	160 J	410 UJ	4800	4400	350 J	820	4900
BENZO(G,H,I)PERYLENE	96 J	410 UJ	1700	2400	170 J	720 U	3500
BENZO(K)FLUORANTHENE	120 J	410 UJ	2100	1800	690 U	630 J	5100 U
BENZOIC ACID	81 J	77 J	190 J	600 U	690 U	102 J	164 J
BIS(2-ETHYLHEXYL)PHTHALATE	550 U	1100 J	780 U	600 U	690 U	1000 U	1400 U
BUTYL BENZYL PHTHALATE	550 U	410 UJ	52 J	600 U	690 U	720 U	570 U
CARBAZOLE	31 J	410 UJ	660	630	690 U	120 J	450 J
CHRYSENE	150 J	410 UJ	3200	2900	250 J	740	4300
DI-N-BUTYL PHTHALATE	550 U	180 J	660 U	600 U	690 U	720 U	570 U
DI-N-OCTYL PHTHALATE	550 U	26 J	660 U	600 U	690 U	720 U	570 U
DIBENZO(A,H)ANTHRACENE	550 U	410 UJ	790	870	690 U	240 J	570 U
DIBENZOFURAN	550 U	410 U	87 J	82 J	690 U	720 U	86 J
FLUORANTHENE	310 J	410 UJ	4600	5200	270 J	1400	6900
FLUORENE	550 U	410 U	110 J	110 J	690 U	46 J	140 J
INDENO(1,2,3-CD)PYRENE	86 J	410 UJ	2200	2400	160 J	500 J	3300
NAPHTHALENE	550 U	410 U	660 U	600 U	690 U	720 U	570 U
PHENANTHRENE	160 J	230 J	2300	2300	140 J	660 J	2000
PHENOL	550 U	32 J	660 U	600 U	690 U	720 U	570 U

TABLE 8-12

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS

STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD1	2WCSD11	2WCSD14	2WCSD14D	2WCSD15	2WCSD2	2WCSD3
LOCATION:	2WCSD1	2WCSD11	2WCSD14	2WCSD14	2WCSD15	2WCSD2	2WCSD3
ZONE:	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1
SAMPLE DATE:	03/09/94	12/20/93	12/21/93	12/21/93	12/21/93	03/09/94	03/09/94
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB

SEMIVOLATILES (UG/KG)

PYRENE	250 J	410 UJ	4600	4000	370 J	1200	6900
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PESTICIDES/PCBs (UG/KG)

4,4'-DDD	32 J	41 UJ					66 J
4,4'-DDE	52 J	41 UJ					57 U
4,4'-DDT	24 J	41 UJ					10 J
ALPHA-CHLORDANE	28 U	21 UJ					29 U
ENDOSULFAN SULFATE	55 U	41 UJ					6.8 J
ENDRIN	55 U	10 J					57 U
ENDRIN ALDEHYDE	55 U	41 UJ					57 U
GAMMA-CHLORDANE	28 U	21 UJ					29 U
HEPTACHLOR	28 J	21 UJ					29 U
METHOXYCHLOR	280 U	210 UJ					290 U

INORGANICS (MG/KG)

ALUMINUM	13100	2560	26400	18500	16900	18700	8860
ANTIMONY	5.1	3.7 U	17.4 U	18.4 U	6.5 U	15.0	9.8
ARSENIC	4.6 J	1.4	11.5	9.0	9.6	6.4 J	5.1 J
BARIUM	53.1	17.9	103	83.4	57.8	85.1	43.3
BERYLLIUM	0.62	0.57 U	2.3 U	1.7 U	1.7 U	1.1	0.75
BORON	16.4 UJ	12.3 U	37.5 J	26.8 J	25.8 J	28.2 UJ	14.7 UJ
CADMIUM	0.66 U	0.49 U	0.8 U	0.72 U	0.82 U	1.1 U	1.0
CALCIUM	1170	680 J	3250 J	2900 J	1750 J	1950	1470
CHROMIUM	18.7	11.4	36.1	27.6	65.2	25.4	14.4
COBALT	6.7	2.3	13.4	9.3	4.3	10.0	7.1
COPPER	16.2	5.0 U	37.7	28.7	26.0	28.0 J	21.6 J
IRON	21800	6430	40700	29000	14700	51600	38400
LEAD	20.4 J	7.9	127	84.6	35.1	53.7 J	48.8 J
MAGNESIUM	3430	1490	5310	4710	5380	4160	2790
MANGANESE	315	150	1480	954	172	423	141
MERCURY	0.16 U	0.12 U	0.2 U	0.18 U	0.52	0.28 U	0.15 U
NICKEL	13.1	5.6	25.8	18.7	16.3	20.9	12.6

TABLE 8-12

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS

STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD1	2WCSD11	2WCSD14	2WCSD14D	2WCSD15	2WCSD2	2WCSD3
LOCATION:	2WCSD1	2WCSD11	2WCSD14	2WCSD14	2WCSD15	2WCSD2	2WCSD3
ZONE:	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1	DRAINAGE AREA-1
SAMPLE DATE:	03/09/94	12/20/93	12/21/93	12/21/93	12/21/93	03/09/94	03/09/94
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB

INORGANICS (MG/KG)

POTASSIUM	1530	822 U	3170	3050	3920	1740	1410
SELENIUM	0.99 UJ	0.49 UJ	1.2 U	0.97 U	1.5 U	1.7 UJ	0.88 UJ
SILVER	0.66 U	0.49 UJ	0.8 UJ	0.72 UJ	0.82 UJ	1.9	1.7
SODIUM	163	28.4 U	169 U	162 U	334 U	314	216
THALLIUM	0.33 U	0.25 U	0.4 U	0.36 J	0.41 U	0.56 U	0.29 U
VANADIUM	24.8	8.0	62.2	45.3	38.1	31.1	18.9
ZINC	71.8	50.4	173	134	42.6	274	216

MISCELLANEOUS PARAMETERS (MG/KG)

TOTAL ORGANIC CARBON		510					
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TABLE 8-12

**SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WCSD10	2WCSD12	2WCSD8	2WCSD9	2WCSD13	2WCSD4	2WCSD5
LOCATION:	2WCSD10	2WCSD12	2WCSD8	2WCSD9	2WCSD13	2WCSD4	2WCSD5
ZONE:	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-3	DRAINAGE AREA-3	DRAINAGE AREA-3
SAMPLE DATE:	01/06/94	12/21/93	12/21/93	12/21/93	12/21/93	12/20/93	12/20/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
VOLATILES (UG/KG)							
1,1,1-TRICHLOROETHANE						18 U	13 J
METHYLENE CHLORIDE						22	10 J
TETRACHLOROETHENE						18 U	8 J
TOLUENE						18 U	4 J
TRICHLOROETHENE						18 U	22
SEMIVOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	510 U	560 U	530 U	430 U	600 U	31 J	630 U
ACENAPHTHENE	510 U	560 U	530 U	430 U	600 U	38 J	630 U
ACENAPHTHYLENE	510 U	560 U	530 U	430 U	600 U	90 J	630 U
ANTHRACENE	510 U	560 U	530 U	430 U	600 U	160 J	630 U
BENZO(A)ANTHRACENE	180 J	95 J	63 J	70 J	120 J	2700 J	250 J
BENZO(A)PYRENE	140 J	110 J	78 J	73 J	130 J	2400 J	210 J
BENZO(B)FLUORANTHENE	350 J	220 J	150 J	160 J	140 J	2500 J	220 J
BENZO(G,H,I)PERYLENE	510 U	59 J	47 J	47 J	100 J	760 J	54 J
BENZO(K)FLUORANTHENE	510 U	560 U	530 U	430 U	120 J	2100 J	240 J
BENZOIC ACID	61 J	93 J	530 U	430 U	600 U	190 J	110 J
BIS(2-ETHYLHEXYL)PHTHALATE	530 U	560 U	530 U	430 U	600 U	710 U	630 U
BUTYL BENZYL PHTHALATE	510 U	560 U	530 U	430 U	600 U	600 UJ	630 U
CARBAZOLE	510 U	560 U	530 U	430 U	600 U	50 J	630 U
CHRYSENE	660	190 J	110 J	130 J	160 J	3300 J	420 J
DI-N-BUTYL PHTHALATE	510 U	560 U	530 U	430 U	600 U	600 U	630 U
DI-N-OCTYL PHTHALATE	510 U	560 U	530 U	430 U	600 U	72 J	630 U
DIBENZO(A,H)ANTHRACENE	510 U	560 U	530 U	430 U	600 U	160 J	630 U
DIBENZOFURAN	510 U	560 U	530 U	430 U	600 U	600 U	630 U
FLUORANTHENE	180 J	190 J	120 J	100 J	170 J	2800	470 J
FLUORENE	510 U	560 U	530 U	430 U	600 U	80 J	630 U
INDENO(1,2,3-CD)PYRENE	86 J	71 J	51 J	49 J	99 J	1200 J	98 J
NAPHTHALENE	510 U	560 U	530 U	430 U	600 U	87 J	160 J
PHENANTHRENE	110 J	120 J	77 J	430 U	600 U	720	250 J
PHENOL	510 U	560 U	530 U	430 U	600 U	600 U	630 U

TABLE 8-12
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD10	2WCSD12	2WCSD8	2WCSD9	2WCSD13	2WCSD4	2WCSD5
LOCATION:	2WCSD10	2WCSD12	2WCSD8	2WCSD9	2WCSD13	2WCSD4	2WCSD5
ZONE:	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-3	DRAINAGE AREA-3	DRAINAGE AREA-3
SAMPLE DATE:	01/06/94	12/21/93	12/21/93	12/21/93	12/21/93	12/20/93	12/20/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
SEMIVOLATILES (UG/KG)							
PYRENE	270 J	210 J	150 J	120 J	270 J	5200	610 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD						6.5 J	63 UJ
4,4'-DDE						60 UJ	63 UJ
4,4'-DDT						60 J	10 J
ALPHA-CHLORDANE						31 UJ	6.4 J
ENDOSULFAN SULFATE						60 UJ	7.6 J
ENDRIN						15 J	18 J
ENDRIN ALDEHYDE						59 J	140 J
GAMMA-CHLORDANE						31 UJ	7 J
HEPTACHLOR						31 UJ	33 UJ
METHOXYCHLOR						310 UJ	37 J
INORGANICS (MG/KG)							
ALUMINUM	12200	13700	12600	4550	12200	15900	10600
ANTIMONY	7.8 J	9.4 U	4.9 U	3.9 U	14.6 U	5.9 U	5.1 U
ARSENIC	6.2 J	8.4	6.7	1.6	11.4	6.9	5.6
BARIUM	78.8 J	72.9	73.2	56.5	50.0	81.1	94.1
BERYLLIUM	0.53 J	1.2 U	1.2 U	0.63 U	1.3 U	1.5 U	1.5 U
BORON	15.9 U	30.2 J	29.3 J	12.9 U	26.3 J	39.7	27.8 J
CADMIUM	0.64 U	0.73 U	0.63 U	0.51 U	0.74 U	1.1 J	29.5
CALCIUM	1660 J	1800 J	2150 J	1440 J	1230 J	2340 J	3290 J
CHROMIUM	41.4	50.5	45.4	8.0	53.1	66.3	27.8
COBALT	7.1 J	5.3	5.6	2.2	4.8	5.6	14.4
COPPER	16.8 J	23.4	23.6	6.1 U	29.5	39.4	57.2
IRON	23800	24600	31200	6920	24600	32700	23700
LEAD	28.0	27.1	22.6	6.7	30.9	49.9	204
MAGNESIUM	4720	5080	4860	2630	5020	5540	4310
MANGANESE	153	168	483	79.8	160	220	2640
MERCURY	0.27 J	0.29	0.18	0.14	0.42	0.38	0.18
NICKEL	13.1 J	15.5	13.8	4.7 J	14.0	18.5	31.5

TABLE 8-12

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS

STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD10	2WCSD12	2WCSD8	2WCSD9	2WCSD13	2WCSD4	2WCSD5
LOCATION:	2WCSD10	2WCSD12	2WCSD8	2WCSD9	2WCSD13	2WCSD4	2WCSD5
ZONE:	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-2	DRAINAGE AREA-3	DRAINAGE AREA-3	DRAINAGE AREA-3
SAMPLE DATE:	01/06/94	12/21/93	12/21/93	12/21/93	12/21/93	12/20/93	12/20/93
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
INORGANICS (MG/KG)							
POTASSIUM	2350 J	3090	2640	2150	4020	3580	2060
SELENIUM	0.67 J	0.73 UJ	0.66 U	0.51 UJ	0.96 U	1.0 U	0.75 U
SILVER	0.64 U	0.73 UJ	0.63 UJ	0.51 UJ	0.74 UJ	0.79 UJ	1.1 U
SODIUM	356 J	209 U	163 U	69.3 U	273 U	580	156 U
THALLIUM	0.96 U	0.37 U	0.31 U	0.26 U	0.37 U	0.39 U	0.34 J
VANADIUM	47.1	41.5	33.4	17.5	37.2	44.5	56.7
ZINC	40.5 J	43.4	82.2	17.3	40.5	61.9	292
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON							16000

TABLE 8-12

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS

STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD6	2WCSD7					
LOCATION:	2WCSD6	2WCSD7					
ZONE:	DRAINAGE AREA-3	DRAINAGE AREA-3					
SAMPLE DATE:	12/21/93	12/20/93					
INVESTIGATION:	PH2-1	PH2-1					
SAMPLE TYPE:	GRAB	GRAB					
VOLATILES (UG/KG)							
1,1,1-TRICHLOROETHANE		11 U					
METHYLENE CHLORIDE		11					
TETRACHLOROETHENE		11 U					
TOLUENE		11 U					
TRICHLOROETHENE		11 U					
SEMI-VOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	700 U	350 U					
ACENAPHTHENE	700 U	43 J					
ACENAPHTHYLENE	700 U	350 U					
ANTHRACENE	65 J	190					
BENZO(A)ANTHRACENE	250 J	900					
BENZO(A)PYRENE	700 U	800					
BENZO(B)FLUORANTHENE	320 J	990					
BENZO(G,H,I)PERYLENE	240 J	260					
BENZO(K)FLUORANTHENE	290 J	620					
BENZOIC ACID	700 U	150 J					
BIS(2-ETHYLHEXYL)PHTHALATE	700 U	350 U					
BUTYL BENZYL PHTHALATE	700 U	350 U					
CARBAZOLE	700 U	230					
CHRYSENE	430 J	1100					
DI-N-BUTYL PHTHALATE	700 U	350 U					
DI-N-OCTYL PHTHALATE	700 U	350 U					
DIBENZO(A,H)ANTHRACENE	700 U	52					
DIBENZOFURAN	700 U	45					
FLUORANTHENE	330 J	1600					
FLUORENE	700 U	76					
INDENO(1,2,3-CD)PYRENE	200 J	480					
NAPHTHALENE	700 U	36 J					
PHENANTHRENE	210 J	1300					
PHENOL	700 U	350 U					

TABLE 8-12
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD6	2WCSD7					
LOCATION:	2WCSD6	2WCSD7					
ZONE:	DRAINAGE AREA-3	DRAINAGE AREA-3					
SAMPLE DATE:	12/21/93	12/20/93					
INVESTIGATION:	PH2-1	PH2-1					
SAMPLE TYPE:	GRAB	GRAB					
SEMIVOLATILES (UG/KG)							
PYRENE	530 J	2500					
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD		35 UJ					
4,4'-DDE		35 UJ					
4,4'-DDT		35 UJ					
ALPHA-CHLORDANE		18 UJ					
ENDOSULFAN SULFATE		35 UJ					
ENDRIN		35 UJ					
ENDRIN ALDEHYDE		35 UJ					
GAMMA-CHLORDANE		18 UJ					
HEPTACHLOR		18 UJ					
METHOXYCHLOR		180 UJ					
INORGANICS (MG/KG)							
ALUMINUM	16900	3510					
ANTIMONY	6.4 U	3.2 U					
ARSENIC	13.5	1.2					
BARIUM	71.2	17.0					
BERYLLIUM	1.0 U	0.55 U					
BORON	34.9 J	11.0 J					
CADMIUM	0.85 U	0.43 U					
CALCIUM	1920 J	922 J					
CHROMIUM	97.5	5.7 U					
COBALT	6.2	2.2					
COPPER	52.8	4.6 U					
IRON	31100	6940					
LEAD	69.6	3.5					
MAGNESIUM	6140	1160					
MANGANESE	196	101					
MERCURY	0.6	0.11 U					
NICKEL	21.5	3.3 J					

TABLE 8-12
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	2WCSD6	2WCSD7					
LOCATION:	2WCSD6	2WCSD7					
ZONE:	DRAINAGE AREA-3	DRAINAGE AREA-3					
SAMPLE DATE:	12/21/93	12/20/93					
INVESTIGATION:	PH2-1	PH2-1					
SAMPLE TYPE:	GRAB	GRAB					
INORGANICS (MG/KG)							
POTASSIUM	4020	870 U					
SELENIUM	0.98 U	0.43 UJ					
SILVER	0.85 UJ	0.43 UJ					
SODIUM	1120	36.0 U					
THALLIUM	0.42 U	0.21 U					
VANADIUM	54.9	12.8					
ZINC	54.9	10.3 U					

TABLE 8-13**SUMMARY OF POSITIVE TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL RESULTS (SEDIMENT)
STUDY AREA H - AREA A WEAPONS CENTER; NSB-NLON, GROTON, CONNECTICUT**

SAMPLE NUMBER:	2WCSD2						
INVESTIGATION:	PH2-1						
SAMPLE DATE:	03/09/94						
LOCATION:	2WCSD2						
SAMPLE TYPE:	GRAB						
STATUS:							
TCLP METALS (MG/L)*							
BARIUM (100.0/10.0)	0.248						

* Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB waters.

TABLE 8-14

**SUMMARY OF PHASE II SEDIMENT ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Analyte	Drainage Area 1 ⁽¹⁾			Drainage Area 2 ⁽²⁾			Drainage Area 3 ⁽³⁾		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)									
Toluene	1/3	2	2WCSD1	-	-	NA ⁽⁴⁾	1/3	4	2WCSD5
Tetrachloroethene	0/3	-	ND	-	-	NA	1/3	8	2WCSD5
1,1,1-Trichloroethane	0/3	-	ND	-	-	NA	1/3	13	2WCSD5
Trichloroethene	0/3	-	ND	-	-	NA	1/3	22	2WCSD5
Methylene chloride	1/3	12	2WCSD11	-	-	NA	3/3	10 - 22	2WCSD4
SEMIVOLATILE ORGANICS (ug/kg)									
Phenol	1/6	32	2WCSD11	0/4	-	ND	0/5	-	ND
Bis(2-ethylhexyl)phthalate	1/6	1100	2WCSD11	0/4	-	ND	0/5	-	ND
Di-n-butylphthalate	1/6	180	2WCSD11	0/4	-	ND	0/5	-	ND
Di-n-octylphthalate	1/6	26	2WCSD11	0/4	-	ND	1/5	72	2WCSD4
Butylbenzylphthalate	1/6	52	2WCSD14	0/4	-	ND	0/5	-	ND
Acenaphthene	3/6	36 - 79	2WCSD3	0/4	-	ND	2/5	38 - 43	2WCSD7
Acenaphthylene	2/6	47-74	2WCSD14	0/4	-	ND	1/5	90	2WCSD4
Anthracene	5/6	22 - 400	2WCSD3	0/4	-	ND	3/5	65 - 190	2WCSD7
Benzo(a)anthracene	5/6	110 - 3400	2WCSD3	4/4	63 - 180	2WCSD10	5/5	120 - 2700	2WCSD4
Benzo(b)fluoranthene	5/6	160 - 4900	2WCSD3	4/4	150 - 350	2WCSD10	5/5	140 - 2500	2WCSD4
Benzo(k)fluoranthene	3/6	120 - 2100	2WCSD14	0/4	-	ND	5/5	120 - 2100	2WCSD4
Benzo(g,h,i)perylene	4/6	96 - 3500	2WCSD3	3/4	47 - 59	2WCSD12	5/5	54 - 760	2WCSD4
Benzo(a)pyrene	4/6	120 - 4400	2WCSD3	4/4	73 - 140	2WCSD10	4/5	130 - 2400	2WCSD4
Chrysene	5/6	150 - 4300	2WCSD3	4/4	110 - 660	2WCSD10	5/5	160 - 3300	2WCSD4
Dibenz(a,h)anthracene	2/6	240 - 870	2WCSD14	0/4	-	ND	2/5	52 - 160	2WCSD4

TABLE 8-14 (Continued)
SUMMARY OF PHASE II SEDIMENT ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Analyte	Drainage Area 1 ⁽¹⁾			Drainage Area 2 ⁽²⁾			Drainage Area 3 ⁽³⁾		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Fluoranthene	5/6	270 - 6900	2WCSD3	4/4	100 - 190	2WCSD12	5/5	170 - 2800	2WCSD4
Fluorene	3/6	46 - 140	2WCSD3	0/4	-	ND	2/5	76 - 80	2WCSD4
Indeno(1,2,3-cd)pyrene	5/6	86 - 3300	2WCSD3	4/4	49 - 86	2WCSD10	5/5	98 - 1200	2WCSD4
2-Methylnaphthalene	0/6	-	ND	0/4	-	ND	1/5	31	2WCSD4
Naphthalene	0/6	-	ND	0/4	-	ND	3/5	36 - 160	2WCSD5
Phenanthrene	6/6	140 - 2300	2WCSD14	3/4	77 - 120	2WCSD12	4/5	210 - 1300	2WCSD7
Pyrene	5/6	250 - 6900	2WCSD3	4/4	120 - 270	2WCSD10	5/5	270 - 5200	2WCSD4
Benzoic acid	5/6	77 - 190	2WCSD14	2/4	61 - 93	2WCSD12	3/5	110 - 190	2WCSD4
Carbazole	4/6	31 - 660	2WCSD14	0/4	-	ND	2/5	50 - 230	2WCSD7
Dibenzofuran	2/6	86 - 87	2WCSD14	0/4	-	ND	1/5	45	2WCSD7

PESTICIDES/PCBs (ug/kg)

Alpha-Chlordane	0/3	-	ND	-	-	NA	1/3	6.4	2WCSD5
Gamma-Chlordane	0/3	-	ND	-	-	NA	1/3	7	2WCSD5
4,4'-DDD	2/3	6.6 - 32	2WCSD1	-	-	NA	1/3	6.5	2WCSD4
4,4'-DDE	1/3	52	2WCSD1	-	-	NA	0/3	ND	ND
4,4'-DDT	2/3	10 - 24	2WCSD1	-	-	NA	2/3	10 - 60	2WCSD4
Endosulfan sulfate	1/3	6.8	2WCSD3	-	-	NA	1/3	7.6	2WCSD5
Endrin	1/3	10	2WCSD11	-	-	NA	2/3	15 - 18	2WCSD5
Endrin aldehyde	0/3	-	ND	-	-	NA	2/3	59 - 140	2WCSD5
Heptachlor	1/3	2.8	2WCSD1	-	-	NA	0/3	ND	ND
Methoxychlor	0/3	-	ND	-	-	NA	1/3	37	2WCSD5

INORGANICS (mg/kg)

Aluminum	6/6	2560 - 26400	2WCSD14	4/4	4550 - 13700	2WCSD12	5/5	3510 - 16900	2WCSD6
Antimony	3/6	5.1 - 15.0	2WCSD2	1/4	7.8	2WCSD10	0/5	-	ND

TABLE 8-14 (Continued)
SUMMARY OF PHASE II SEDIMENT ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Analyte	Drainage Area 1 ⁽¹⁾			Drainage Area 2 ⁽²⁾			Drainage Area 3 ⁽³⁾		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Arsenic	6/6	1.4 - 11.5	2WCSD14	4/4	1.6 - 8.4	2WCSD12	5/5	1.2 - 13.5	2WCSD6
Barium	6/6	17.9 - 103	2WCSD14	4/4	56.5 - 78.8	2WCSD10	5/5	17.0 - 94.1	2WCSD5
Beryllium	3/6	0.62 - 1.1	2WCSD2	1/4	0.53	2WCSD10	0/5	-	ND
Boron	2/6	25.8 - 37.5	2WCSD14	2/4	29.3 - 30.2	2WCSD12	5/5	11.0 - 39.7	2WCSD4
Cadmium	1/6	1.0	2WCSD3	0/4	-	ND	2/5	1.1 - 29.5	2WCSD5
Calcium	6/6	680 - 3250	2WCSD14	4/4	1440 - 2150	2WCSD8	5/5	922 - 3290	2WCSD5
Chromium	6/6	11.4 - 65.2	2WCSD15	4/4	8.0 - 50.5	2WCSD12	4/5	27.8 - 97.5	2WCSD6
Cobalt	6/6	2.3 - 13.4	2WCSD14	4/4	2.2 - 7.1	2WCSD10	5/5	2.2 - 14.4	2WCSD5
Copper	5/6	16.2 - 37.7	2WCSD14	3/4	16.8 - 23.6	2WCSD8	4/5	29.5 - 57.2	2WCSD5
Iron	6/6	6430 - 51600	2WCSD2	4/4	6920 - 31200	2WCSD8	5/5	6940 - 32700	2WCSD4
Lead	6/6	7.9 - 127	2WCSD14	4/4	6.7 - 28.0	2WCSD10	5/5	3.5 - 204	2WCSD5
Magnesium	6/6	1490 - 5380	2WCSD15	4/4	2630 - 5080	2WCSD12	5/5	1160 - 6140	2WCSD6
Manganese	6/6	141 - 1480	2WCSD14	4/4	79.8 - 483	2WCSD8	5/5	101 - 2640	2WCSD5
Mercury	1/6	0.52	2WCSD15	4/4	0.14 - 0.29	2WCSD12	4/5	0.18 - 0.60	2WCSD6
Nickel	6/6	5.6 - 25.8	2WCSD14	4/4	4.7 - 15.5	2WCSD12	5/5	3.3 - 31.5	2WCSD5
Potassium	5/6	1410 - 3920	2WCSD15	4/4	2150 - 3090	2WCSD12	4/5	2060 - 4020	2WCSD6
Selenium	0/6	-	ND	1/4	0.67	2WCSD10	0/5	-	ND
Silver	2/6	1.7 - 1.9	2WCSD2	0/4	-	ND	0/5	-	ND
Sodium	3/6	163 - 314	2WCSD2	1/4	356	2WCSD10	2/5	580 - 1120	2WCSD6
Thallium	1/6	0.36	2WCSD14	0/4	-	ND	1/5	0.34	2WCSD5

TABLE 8-14 (Continued)
SUMMARY OF PHASE II SEDIMENT ANALYTICAL RESULTS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Analyte	Drainage Area 1 ⁽¹⁾			Drainage Area 2 ⁽²⁾			Drainage Area 3 ⁽³⁾		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Vanadium	6/6	8.0 - 62.2	2WCSD14	4/4	17.5 - 47.1	2WCSD10	5/5	12.8 - 56.7	2WCSD5
Zinc	6/6	42.6 - 274	2WCSD2	4/4	17.3 - 82.2	2WCSD8	4/5	40.5 - 292	2WCSD5
TCLP (mg/L)									
Barium (100.00/10) ⁽⁶⁾	1/1	0.248	2WCSD2	-	-	NA	-	-	NA

- 1 Includes samples 2WCSD1, 2WCSD2, 2WCSD3, 2WCSD11, 2WCSD14, 2WCSD14-D (field duplicate of 2WCSD14), and 2WCSD15. Duplicate sample results are averaged and counted as one sample.
- 2 Includes samples 2WCSD8, 2WCSD9, 2WCSD10, and 2WCSD12.
- 3 Includes samples 2WCSD4, 2WCSD5, 2WCSD6, 2WCSD7, and 2WCSD13.
- 4 Not Analyzed.
- 5 Not Detected.
- 6 Values in parentheses represent Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Clean-Up Standard Pollutant Mobility Criteria for GB waters.

TABLE 8-15
CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration ⁽¹⁾				
	Surface Soil (mg/kg)	All Soil (mg/kg)	Groundwater (mg/L)	Surface Water (mg/L)	Sediment (mg/kg)
1,2-Dichloroethane	NA ⁽²⁾	NA	0.003 ⁽³⁾	NA	NA
1,1,2-Trichloroethane	NA	NA	0.003 ⁽³⁾	NA	NA
Trichloroethene	NA	NA	0.003 ⁽³⁾	NA	NA
Benzo(a)anthracene	0.68/2.1	0.39/2.1	NA	NA	2.3
Benzo(b)fluoranthene	0.96/3.2	0.55/3.2	NA	NA	4.9
Benzo(a)pyrene	0.61/1.8	0.35/1.8	NA	NA	2.7
Dibenz(a,h)anthracene	0.27/0.57	0.23/0.57	0.003 ⁽³⁾	NA	0.29/0.87
Indeno(1,2,3-cd)pyrene	0.38/1.0	0.25/1.0	0.003 ⁽³⁾	NA	1.9
Antimony	5.0/5.4	5.4 ⁽³⁾	0.0090/0.0117 ⁽⁴⁾	NA	5.2/15.0
Arsenic	1.5/3.5	4.7/10.8	0.0073/0.0159	0.0016/0.0026	8.4
Beryllium	0.28/0.48	0.44/0.68	0.00082/0.0012	NA	0.65/1.1
Boron	NA	NA	1.14/2.46	NA	NA
Cadmium	NA	NA	NA	0.0036/0.0066	2.4/29.5
Chromium	NA	30.7/78.7	0.0083/0.0232	NA	49.5
Lead	NA	NA	0.0039/0.0089	NA	NA
Manganese	172/257	211/390	3.42/5.07	NA	459/2640
Thallium	NA	NA	0.0045/0.0082	NA	NA
Vanadium	NA	NA	NA	NA	42.7

- 1 UCL if single concentration presented, otherwise average for CTE and maximum for RME. For groundwater, maximum is defined as the highest average concentration in a single well, and average is defined as the overall average concentration of all well-specific averages.
- 2 NA - Not applicable. Chemical is not a chemical of concern for this medium.
- 3 Maximum. Chemical detected infrequently.
- 4 Dissolved fraction only. Antimony not detected in unfiltered samples.

TABLE 8-16
ESTIMATED RISKS⁽¹⁾
STUDY AREA H - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Hazard Index						Incremental Cancer Risk					
	Full-Time Employee		Construction Worker		Future Resident		Full-Time Employee		Construction Worker		Future Resident	
	RME ⁽²⁾	CTE ⁽³⁾	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Incidental Ingestion of Soil	2.1E-2	3.6E-2	1.8E-1	1.7E-2	1.3E-1	1.9E-2	6.1E-6	1.4E-7	1.3E-6	7.5E-8	2.8E-5	7.6E-7
Dermal Contact with Groundwater	NA ⁽⁴⁾	NA	1.5E+0	6.1E-1	7.0E-1	2.0E-1	NA	NA	2.7E-7	1.2E-7	4.2E-6	3.9E-7
Ingestion of Groundwater	NA	NA	NA	NA	1.2E+1	3.4E+0	NA	NA	NA	NA	6.3E-4	6.4E-5
Inhalation of Volatiles in Groundwater	NA	NA	NA	NA	3.4E-2	1.6E-2	NA	NA	NA	NA	5.6E-6	7.9E-7
Cumulative Risk:	2.1E-2	3.6E-2	1.7E+0	6.3E-1	1.3E+1	3.6E+0	6.1E-6	1.4E-7	1.6E-6	2.0E-7	6.7E-4	6.6E-5

- 1 Chemical-specific risks presented in Appendix F.7.
- 2 RME - Reasonable Maximum Exposure.
- 3 CTE - Central Tendency Exposure.
- 4 NA - Not applicable; exposure route not evaluated for this receptor.

TABLE 8-17

**ECOLOGICAL CHEMICALS OF CONCERN
FOR TERRESTRIAL AND AQUATIC RECEPTORS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Chemical of Concern	Terrestrial Receptors								Aquatic Receptors			
	Terrestrial Vegetation		Soil Invertebrates		Short-Tailed Shrew		Red-Tailed Hawk		Surface Water		Sediments	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
Benzo(a)anthracene	NA ⁽¹⁾	NA	NA	NA	X ⁽²⁾	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	X	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	X	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	X	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	X	X	NA	NA	NA	NA	X	NA
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Endrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Endrin aldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Endosulfan sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Gamma-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Aluminum	X	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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TABLE 8-17 (Continued)
ECOLOGICAL CHEMICALS OF CONCERN
FOR TERRESTRIAL AND AQUATIC RECEPTORS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Terrestrial Receptors								Aquatic Receptors			
	Terrestrial Vegetation		Soil Invertebrates		Short-Tailed Shrew		Red-Tailed Hawk		Surface Water		Sediments	
	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN	MAX	MEAN
Antimony	X	NA	NA	NA	X	X	X	X	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	NA
Barium	NA	NA	NA	NA	X	X	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	X	X	NA	NA	X	X	X	X
Chromium	X	X	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Iron	NA	NA	NA	NA	NA	NA	NA	NA	X	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	X	X	X	NA
Manganese	NA	NA	NA	NA	X	X	NA	NA	NA	NA	X	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	X	NA
Selenium	X	X	NA	NA	NA	NA	NA	NA	NA	NA	X	X
Vanadium	X	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	X	X	X	NA

**TABLE 8-17 (Continued)
ECOLOGICAL CHEMICALS OF CONCERN
FOR TERRESTRIAL AND AQUATIC RECEPTORS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT**

Notes

- 1) NA - not applicable. Chemical is not chemical of concern for this receptor.
- 2) X - Chemical of concern for this receptor.

TABLE 8-18

MAJOR CONTRIBUTORS TO RISK FOR AQUATIC RECEPTORS
BASED ON MAXIMUM SURFACE WATER CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Cadmium	2.5E+1
Lead	2.1E+1
Zinc	1.1E+1
Iron	1.1E+0

TABLE 8-19

MAJOR CONTRIBUTORS TO RISK FOR AQUATIC RECEPTORS
BASED ON AVERAGE SURFACE WATER CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Cadmium	1.4E+1
Lead	1.7E+1
Zinc	6.0E+0

TABLE 8-20

HAZARD QUOTIENTS FOR BENTHIC INVERTEBRATES
BASED ON MAXIMUM SEDIMENT CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Gamma-Chlordane	3.6E+2
Cadmium	4.9E+1
Endrin aldehyde	2.3E+1
4,4'-DDE	1.6E+1
Selenium	6.7E+0
4,4'-DDT	6.0E+0
Methoxychlor	5.9E+0
Manganese	5.7E+0
Endosulfan sulfate	5.3E+0
4,4'-DDD	5.0E+0
Heptachlor	4.2E+0
Lead	4.0E+0
Endrin	3.0E+0
Copper	2.1E+0
Zinc	2.1E+0
Mercury	2.0E+0
Chromium	1.9E+0
Arsenic	1.4E+0
Nickel	1.2E+0
Phenanthrene	1.1E+0

TABLE 8-21

HAZARD QUOTIENTS FOR BENTHIC INVERTEBRATES
BASED ON AVERAGE SEDIMENT CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Gamma-Chlordane	3.6E + 2
4,4'-DDE	9.3E + 0
Endrin aldehyde	8.0E + 0
Methoxychlor	5.9E + 0
Endosulfan sulfate	5.3E + 0
Selenium	4.7E + 0
Heptachlor	4.2E + 0
Cadmium	4.0E + 0
4,4'-DDD	3.0E + 0
Endrin	3.0E + 0
4,4'-DDT	2.4E + 0
Copper	1.6E + 0
Chromium	1.4E + 0
Mercury	1.2E + 0

TABLE 8-22

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MAXIMUM SOIL CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	1.9E+2
Chromium	1.2E+1
Vanadium	9.0E+0
Antimony	1.1E+0

TABLE 8-23

HAZARD QUOTIENTS FOR TERRESTRIAL VEGETATION
BASED ON MEAN SOIL CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Hazard Quotient
Aluminum	1.3E+2
Chromium	9.8E+0
Vanadium	7.4E+0

TABLE 8-24

MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MAXIMUM CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Antimony	9.7E+1	71.2
	Phenanthrene	1.1E+1	8.3
	Barium	1.1E+1	7.9
	Cadmium	3.0E+0	2.2
	All others	1.4E+1	10.4
	Total Receptor HI	1.4E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Red-Tailed Hawk	Soil	7.5E+1	55.3
	Food	6.1E+2	44.6
	Water	1.3E-1	0.1
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	Antimony	2.2E+0	50.4
	4,4'-DDE	8.1E-1	18.5
	Indeno(1,2,3-Cd)pyrene	3.0E-1	7.0
Red-Tailed Hawk	Zinc	2.7E-1	6.3
	All others	7.8E-1	17.9
	Total Receptor HI	4.4E+0	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	2.9E+0	66.3
	Food	1.5E+0	33.4
	Water	1.4E-2	0.3

TABLE 8-25

MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
BASED ON MEAN CONCENTRATIONS
SITE 20 - AREA A WEAPONS CENTER
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Antimony	9.0E+1	79.8
	Barium	1.1E+1	9.6
	Phenanthrene	3.4E+0	3.0
	Manganese	2.6E+0	2.4
	All others	5.9E+0	5.2
	Total Receptor HI	1.3E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	6.4E+1	57.5
	Food	4.8E+1	42.4
	Water	1.3E-1	0.1
Red-Tailed Hawk	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
	Antimony	2.0E+0	57.1
	4,4'-DDE	8.1E-1	22.7
	Zinc	1.7E-1	4.7
	Barium	1.5E-1	4.2
	All others	4.1E-1	11.4
	Total Receptor HI	3.6E+0	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	2.5E+0	69.9
	Food	1.1E+0	29.7
	Water	1.4E-2	0.4

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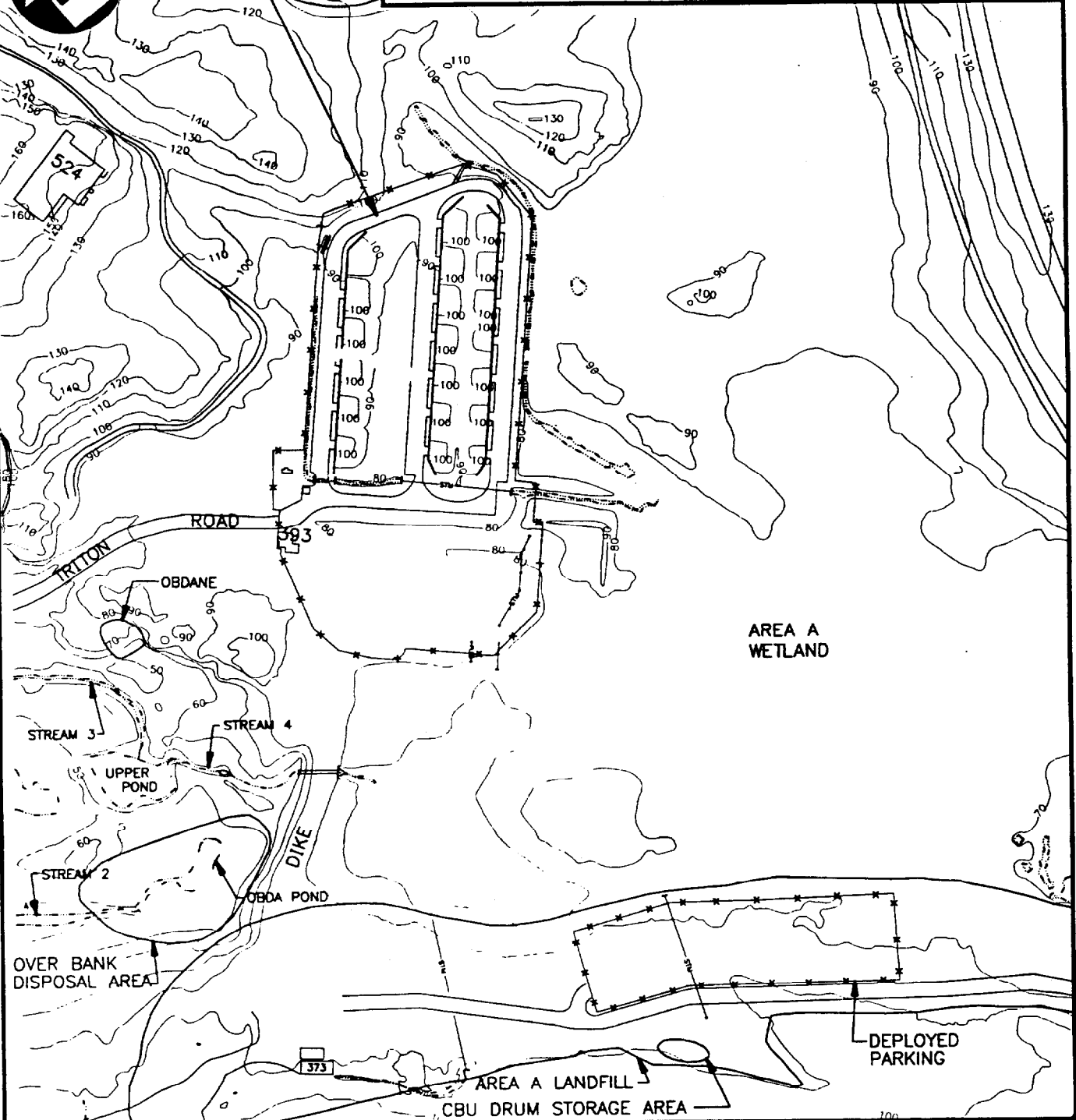
PLOT LIMITS



AREA A
WEAPONS
CENTER

NOTE:

1. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)



0 250
SCALE IN FEET

LEGEND

- 10 — EXISTING CONTOUR
- 123 BUILDING No.
- WATERCOURSE
- STM — CATCH BASIN
- EXPOSED BEDROCK
- FENCE

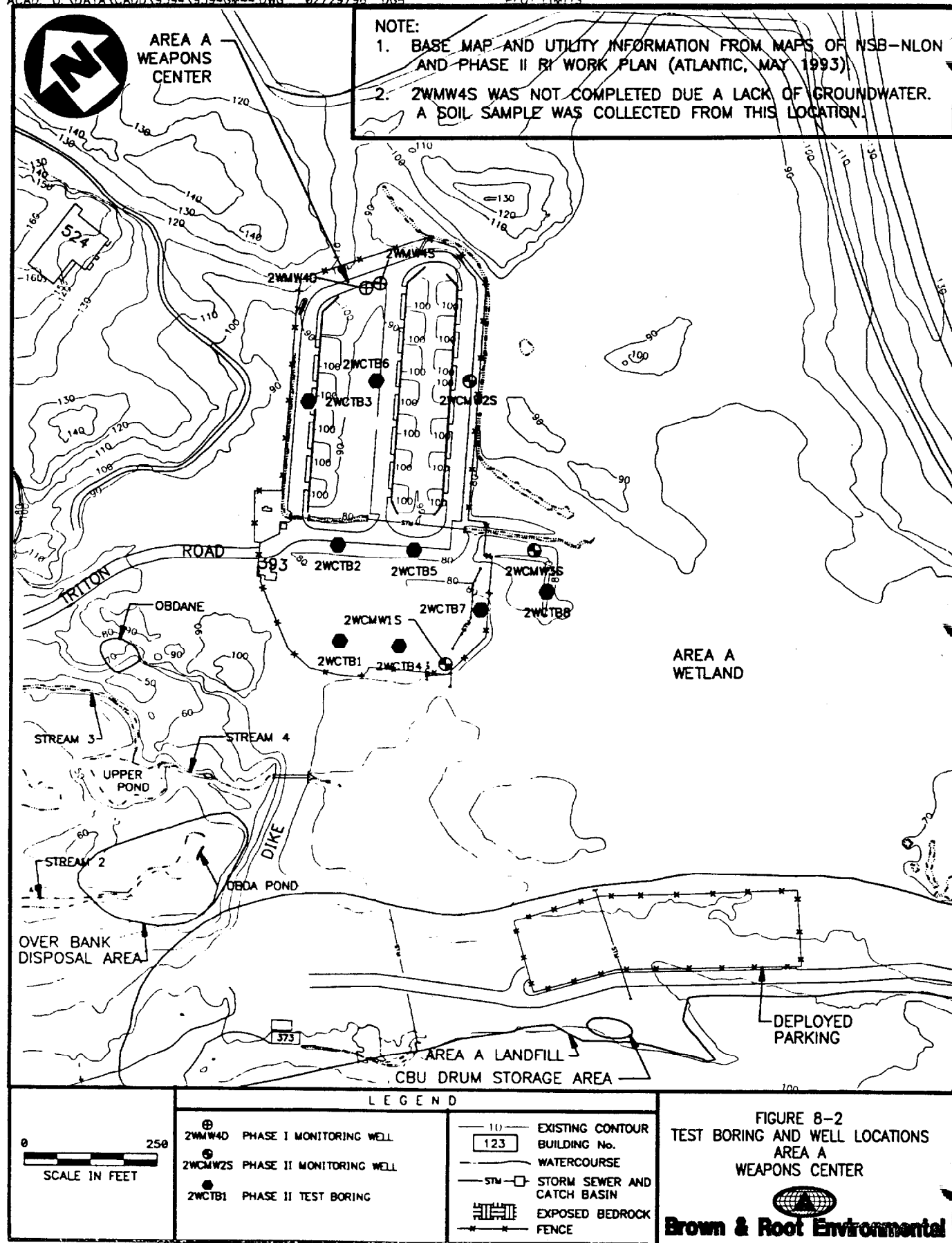
FIGURE 8-1
GENERAL SITE ARRANGEMENT
AREA A
WEAPONS CENTER



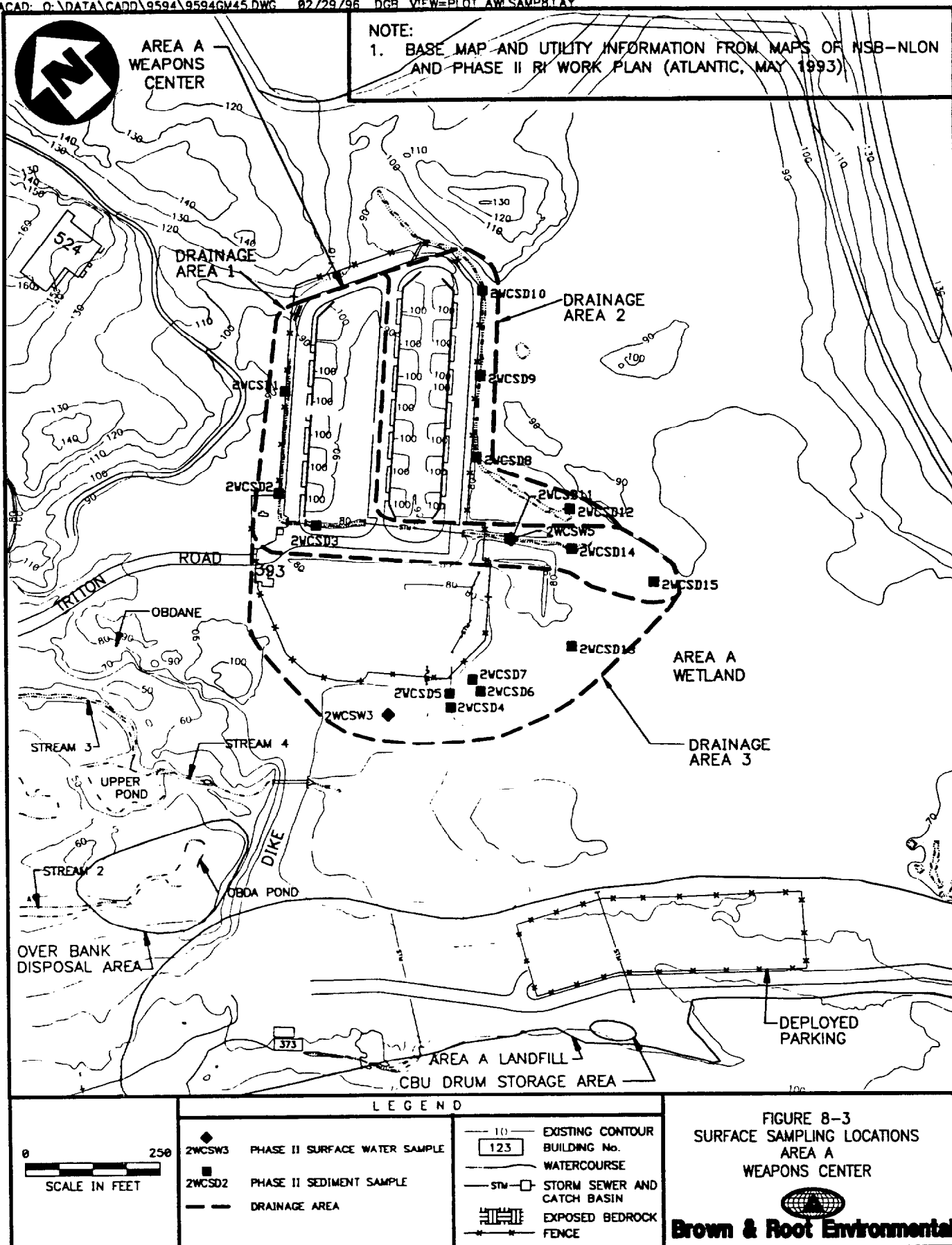
Brown & Root Environmental

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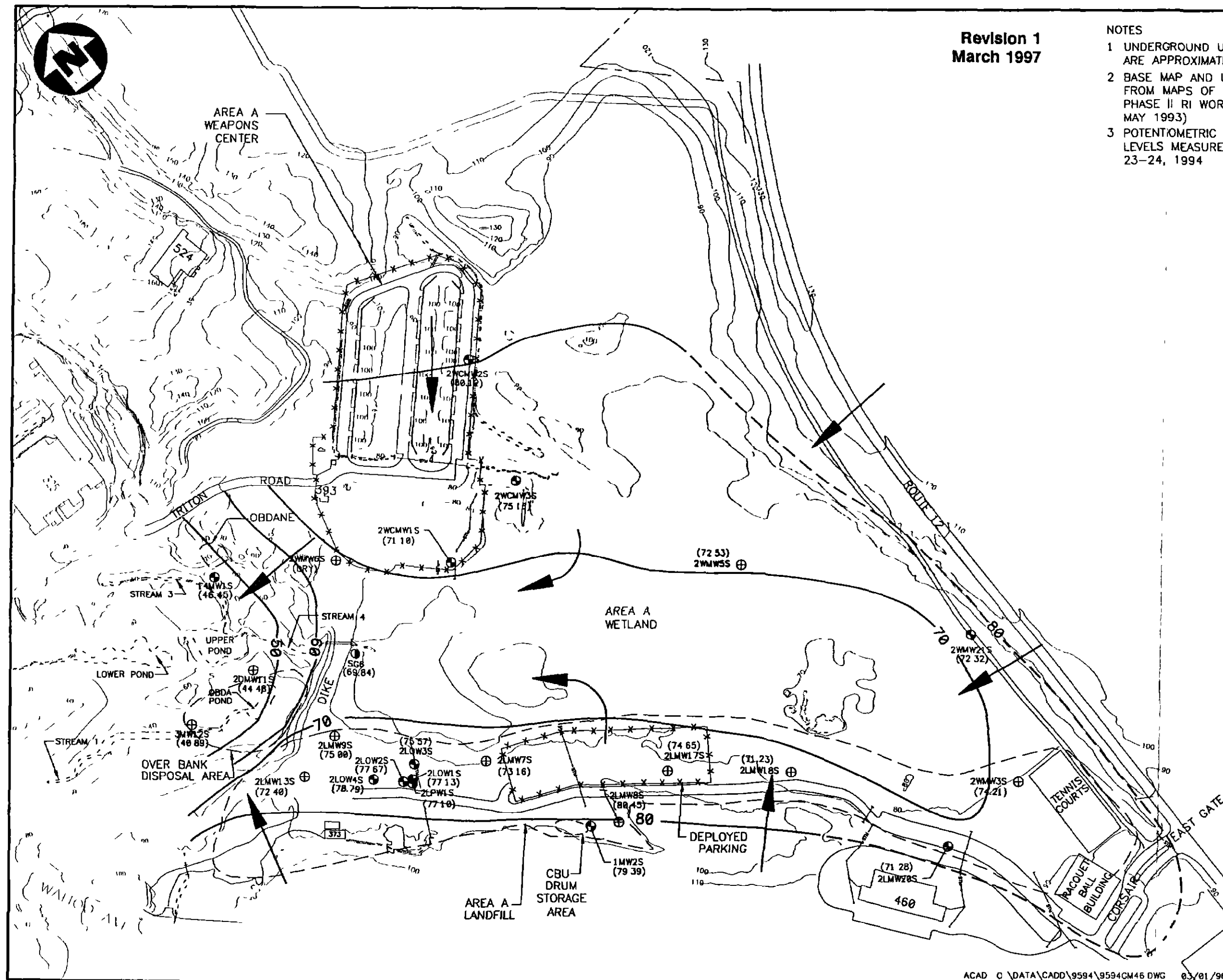
PLOT LIMITS



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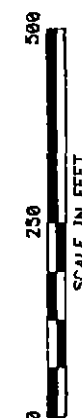
Revision 1
March 1997

- NOTES
- 1 UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE
 - 2 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC MAY 1993)
 - 3 POTENTIOMETRIC SURFACE FOR WATER LEVELS MEASURED ON AUGUST 23-24, 1994

FIGURE 8-4
SHALLOW OVERBURDEN
POTENTIOMETRIC SURFACE MAP
AREA A LANDFILL,
WETLAND, AND WEAPONS CENTER

Brown & Root Environmental

- LEGEND
- | | |
|--|--|
| <p>① PHASE I MONITORING WELL</p> <p>② PHASE II MONITORING WELL</p> <p>③ PHASE II STAFF GAUGE</p> <p>--- POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)</p> <p>--- GROUNDWATER ELEVATION (11 MSL)</p> | <p>--- EXISTING CONTOUR</p> <p>123 BUILDING NO</p> <p>--- WATERCOURSE</p> <p>--- STORM SEWER AND CATCH BASIN</p> <p>--- EXPOSED BEDROCK</p> <p>--- GROUNDWATER FLOW DIRECTION</p> <p>--- FENCE</p> |
|--|--|



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PLOT LIMITS

Revision 1
March 1997

NOTES

- 1 UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE
- 2 BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993)
- 3 POTENTIOMETRIC SURFACE FOR WATER LEVELS MEASURED ON AUGUST 23-24, 1994

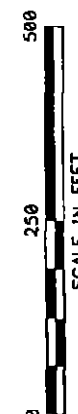
FIGURE 8-5

BEDROCK
POTENTIOMETRIC SURFACE MAP
AREA A LANDFILL,
WETLAND, AND WEAPONS CENTER



Brown & Root Environmental

LEGEND	
2LW190D (44 82)	EXISTING CONTOUR
2LW190D (44 82)	WATERCOURSE
2LW190D (44 82)	STORM SEWER AND CATCH BASIN
2LW190D (44 82)	EXPOSED BEDROCK
2LW190D (44 82)	FENCE
2LW190D (44 82)	GROUNDWATER FLOW DIRECTION
2LW190D (44 82)	PHASE I MONITORING WELL
2LW190D (44 82)	PHASE II MONITORING WELL
2LW190D (44 82)	RESIDENTIAL WELL
2LW190D (44 82)	POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
2LW190D (44 82)	GROUNDWATER ELEVATION (ft MSL)



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PLOT LIMITS

